U.S.-CHINA TRADE IMPACTS ON THE U.S. DEFENSE INDUSTRIAL BASE

HEARING

BEFORE THE

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

ONE HUNDRED NINTH CONGRESS

FIRST SESSION

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The Commission's Statutory Mandate begins on page 185.

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

NOVEMBER 10, 2005

The Honorable TED STEVENS,
President Pro Tempore of the U.S. Senate, Washington, D.C. 20510
The Honorable J. DENNIS HASTERT,
Speaker of the House of Representatives, Washington, D.C. 20515

DEAR SENATOR STEVENS AND SPEAKER HASTERT:

On behalf of the U.S.-China Economic and Security Review Commission, we are pleased to release the record of our June 23, 2005 public hearing in Washington, DC. The hearing entitled "*U.S.-China Trade Impacts on the U.S. Defense Industrial Base*" highlighted disturbing vulnerabilities in the U.S. defense-related economy. In particular, the hearing focused on the current and future trends in the globalization of the defense industrial base, China's trade and investment behavior in defense-related industries, and the need for immediate action to preserve U.S. leadership in technological innovation. An electronic copy of the hearing record is posted to the Commission's Web site at *www.uscc.gov*.

Congressman Donald Manzullo opened the hearing by describing the disincentives faced by U.S. companies wanting to conduct their manufacturing and other operations in the U.S. compared to the multiple incentives foreign nations, including China, use to attract companies in key dual-use industries. The Commission also heard from Peter Lichtenbaum, Acting Under Secretary of Commerce for Industry and Security, concerning the Commerce Department's role in monitoring the health of the U.S. defense industrial base. Additionally, the Department of Defense (DoD) submitted written testimony for the record.[1] William Schneider, Chairman of the Defense Science Board (DSB), discussed how defense needs are changing in light of the new realities of warfare. The Commission also heard testimony from representatives of and experts on the semiconductor, aerospace, information technology, specialty metals, machine tools, and shipping industries.

As Acting Under Secretary Lichtenbaum stated at the hearing: "U.S. trade with China and Chinese investment decisions do have a significant impact on the defense industrial base." Following are the Commission's key findings based on the information provided in the testimony and the question-and-answer sessions:

- The U.S. defense establishment is heavily and increasingly reliant on the technologies produced by the private sector for civilian use. The private sector has moved offshore much of the production and is beginning to move offshore some of the design for these technologies that are used in the defense sector.

[1] The Commission invited two Defense Department officials to testify, but both declined due to scheduling conflicts: The Honorable Kenneth J. Krieg, Under Secretary of Defense for Acquisition, Technology, and Logistics, and The Honorable Suzanne Patrick, Deputy Under Secretary of Defense for Industrial Policy.

- The DoD "trusted" and "assured"[2] supply of high-performance microchips is at a critical point due to restructuring in the commercial integrated circuit industry that has moved operations offshore to Taiwan, Singapore, and China.
- Foreign governments, most notably China, provide incentives to attract certain technological industries, including the semiconductor industry. (In fact, these incentives have resulted in movement of some production and R&D activities from the U.S.) U.S. market-based companies must compete against these government-supported companies.
- In China, funding incentives to attract certain industries are part of a coordinated, strategic effort by the government to both attract dual-use industry companies to China and acquire them abroad. Most notably this strategy is focused on the software and integrated circuits industries—the two key industries the U.S. defense establishment identifies as vital to today's information-based, network-centric warfare.

The nature of modern warfare has changed since the Cold War. In response to these changes, DoD changed its acquisition model to reflect the current nature of a globalized defense industrial base. While the previous defense acquisition model was premised on acquiring the necessary materiel to enable the U.S. to fight two and one-half wars simultaneously, today's model relies on utilizing whatever current capacity (both in the U.S. and among our allies) is present when hostilities commence.

DoD currently defines the "defense industrial base" by functional concepts, identifying five such concepts: battlespace awareness, command and control, force application, protection, and focused logistics. To assess the health of the defense industrial base, DoD identifies the critical technologies required to meet the goals of these functional concepts. Then it identifies and assesses the industries critical to those technologies.

Today's defense industrial base is defined as network-centric rather than platform-centric as in the past. In essence, the present day U.S. military draws its strength from the knowledge of processes and its effectiveness in using information in each operation. As Dr. Schneider testified, this means the most critical aspect of the defense industrial base is the ability to produce and communicate information—information technology and its supporting systems.

The defense establishment today relies almost entirely on technologies produced by the private sector for civilian use, particularly information technology. This marks a profound change from the Cold War era when weapons systems, components, and other materiel frequently were designed and manufactured specifically for the military using unique military specifications. The DSB currently is conducting a study with the British Ministry of Defense to identify the technologies important for national defense that are not being developed by the private sector for civilian use. This study is critical because, as Dr. Schneider noted, "one of the things that I think

[2] A "trusted source" ensures the protection of classified designs, the integrity of mission-critical components, and long operating life. An "assured source" guarantees access for special military needs, quick response for time-critical chip designs, and parts availability for the life of the system utilizing them.

is especially interesting about the current time in defense technology is it's the first time . . . since the '50s where defense requirements are, in a number of areas, considerably more demanding than civilian applications." The 1950s were a time when the U.S. Government began marshaling a vision of science and technology innovation. This hearing emphasized that it is time to revive such an effort.

At present, U.S. market-based companies producing defense-related items are competing against foreign companies supported by their governments. For example, Congressman Manzullo noted that Israel, Taiwan, Singapore, and, in particular, China have provided government support and subsidies to encourage firms to build semiconductor foundries in their countries. In defense contracting where, appropriately, DoD generally seeks the lowest-priced contract, unsubsidized U.S. firms sometimes lose contracts to firms subsidized by foreign governments. This creates a dilemma for U.S. policy: choosing between the lowest-priced contracts at the cost of hurting U.S. defense industries and even seeing some companies dissolve or become unwilling to engage in defense manufacturing, or paying a premium in an effort to preserve U.S. defense firms. This is a difficult and critical choice that merits more careful attention and decisionmaking than it typically has received.

Dr. Schneider cited the worrisome implications of this situation:

> "The underlying problem is that the economic incentives for globalizing the supply chain are omnipresent and are affecting almost every industry, and it is necessarily the case that what is an optimum solution for least cost production of software or least cost production of electronic equipment is not one that produces an effective security system and indeed a determined player can exploit the globalization of the supply chain."

Acting Under Secretary Lichtenbaum testified that, since 2001, the Commerce Department has been asked by DoD to produce 18 studies on the state of the industrial base in a variety of defense sectors. Firms responding to these studies reported that they are unable to adequately maintain research and development (R&D) levels, invest in production and process improvements, and retain qualified engineers or scientists, and, as a result, some companies that were committed to supplying DoD have migrated to commercial sectors or downsized their defense-related operations.

Dr. Schneider told the Commission there has been a decline in basic research, and he offered a possible prescription to address that problem:

> "[D]efense laboratories have tended to be focused on the application of advanced technology for military purposes and have not focused very much on basic technology, but it may be necessary for DoD to acknowledge the fact that there is a lot of technology that's now being produced in the civil sector that has applications to defense and focus on industry making that transition, perhaps by reducing some of the institutional barriers to more effective collaboration between the non-defense sector and the defense sector and getting the government laboratories to work in a

more focused way on supporting some of the work in basic research and in collaboration with universities which are ultimately the source of a lot of this work."

The Semiconductor Industry

Earlier this year, the DSB released a report on the adequacy and security of the microchip supply for defense needs. The head of the DSB task force on high performance microchip supply, William Howard, testified that the United States' secure supply of high-performance microchips is in jeopardy, and that this problem requires an urgent response.

DoD has relied on the civil production of chips for its supply. This has proven cost efficient given the extremely high cost of maintaining government production facilities. As the commercial chip industry has restructured over the past several years, expensive manufacturing capacity moved abroad, mostly to Taiwan, Singapore, and China. Dr. Howard noted that chip design is now beginning to follow. This threatens DoD's ability to ensure against tampering with its chip supply, particularly its application-specific integrated circuits. Especially with respect to China, this trend is expected to continue. The Chinese government has an aggressive, coordinated strategy to rapidly build its semiconductor sector. This strategy employs investment, financing, tax, industrial, export, and education policies to support the Chinese semiconductor industry and attract foreign semiconductor operations to China.

Currently there are only three integrated circuit fabricators in the U.S.: IBM, Intel, and Texas Instruments. Because the only one of these that has agreed to conduct business with the Federal Government is IBM, it was chosen as a "Trusted Foundry" and was given a "take-or-pay" contract by DoD worth $600 million over 10 years. Dr. Howard, while pleased that the immediate concern is addressed by this program, said it is risky to use a sole-source supplier because of the possibility the supplier's ability to produce chips could be substantially degraded in the future. He strongly recommended that the government devise a strategy to ensure a supply of chips that is both trusted and assured.

The Aerospace Industry

The ability of the U.S. aerospace industry to maintain an advanced level of high-technology performance also is apparently at risk. Witnesses testified that the risk will only increase as more aerospace technologies migrate offshore, and to the extent the U.S. civilian industrial base continues its growing focus on knowledge generation rather than creation of hardware. As Dr. Schneider stated, "That does pose a challenge for how the U.S. will be able to maintain its leadership and . . . sustain a capability to support the national strategy of maintaining a decisive technology edge in military performance."

Pierre Chao of the Center for Strategic and International Studies testified that after the corporate consolidation of much of the aerospace industry, aerospace subcontractors have been forced to look offshore for new work because there are fewer contractors that are potential purchasers and fewer U.S. aerospace projects that need work done in the United States.

The Software/Information Technology Industry

Process knowledge is becoming more important to defense than hardware knowledge. With this being the case, while the hardware for certain systems may be mundane by current-day technology standards, the software that directs these systems and enables them to perform particular functions is, as Dr. Schneider states, "exotic and the industry that creates that software is a national asset." The Commission heard testimony that the globalization of the software development industry poses a severe risk to U.S. security, because software writers can incorporate various vulnerabilities that are very difficult or effectively impossible to identify, and those vulnerabilities later can be exploited by adversaries.

The Machine Tools Industry

Machine tools are critical to national defense, evidenced by the fact that the U.S. imposes export controls on machine tools and their supporting systems because of their importance to products on which the military relies. These export controls are generally guided by the concept that manufacturing technology is often more important than the products of that technology. Yet there is a contradictory relationship between export controls for U.S. national security purposes and the ability to maintain the U.S. machine tool industry for defense purposes.

The inconsistencies between U.S. export controls and the export controls of other major supplier nations have led to a decrease in U.S. market share for machine tools. Dr. Paul Freedenberg, Vice President of the Association for Manufacturing Technology, testified that a decrease in the capacity of the U.S. machine tool industry has hurt the ability of the United States to mobilize in the event of a national emergency. The U.S. machine tool industry saw its domestic share decrease by 60 percent from 1998 to 2002, with a slight increase in 2003.

The Specialty Metals Industry

Specialty steel, aluminum, beryllium, nickel, titanium, and base superalloys are critical to U.S. weapons systems. Panelist Jack Shilling of Allegheny Technologies testified that specialty metals are essential elements of virtually every U.S. military platform. This importance, however, has not been fully reflected in national security policy or actions in recent years. Efforts have been substantially reduced from those during the Cold War to maintain a current awareness of how critical such speciality metals are for U.S. weapons systems and of the adequacy and reliability of their supply. And amounts of these metals in the U.S. defense stockpile have been permitted to drop—in most cases drastically—from levels in earlier years.

This picture is of even greater concern because there is increasing international competition for the available supplies of many of the specialty metals, and China is a leading competitor for many of them. For example, Chinese demand for titanium is increasing, and its factories that use the metal are searching for additional sources and are seeking to acquire either the ore or other upstream forms of the metal—or even the sources themselves—because it

does not have a sufficient indigenous supply. This and other competition for supplies of these metals unquestionably will have availability and price consequences for U.S. acquisition.

DoD appears to be awakening to the troubling implications of this situation and has begun to take steps to address it. It recently allocated $6 million to establish a domestic production facility for high purity beryllium metal. And, although defense capabilities studies in recent years have not included assessments of the health of the specialty metals industry or the adequacy of the supply of these metals for U.S. defense needs, DoD currently is undertaking a study of the adequacy of U.S. Government access to specialty metals for defense needs and, in particular, how China's increasing demand for them is affecting U.S. access. DoD stated in written testimony to the Commission:

> *"Recent price and schedule trends for metals important to defense, such as steel, aluminum, and titanium, appear to be influenced by China's increasing internal demand, which is likely to persist for years to come. The prices of aerospace grade steel, aluminum, and titanium have risen considerably over the last two years. In addition to these price increases, acquisition lead times for these materials also have increased. Some experts believe that China is responsible for these trends while others are of the opinion that the increases are caused by economic trends associated with widening industrial globalization. Whatever the case, the Department is taking steps to understand the potential impact of these trends and inform planning for future acquisition budgets accordingly."*

Not only the specialty metals themselves but also the technologies to work with them are vital to U.S. defense industries and to the U.S. military advantage. Dr. Shilling testified that the Chinese have aggressively and repeatedly sought to exchange Chinese market access for the ability to purchase Western technology in the specialty metals industry which, thus far, his company (Allegheny Technologies) has chosen not to sell. According to Dr. Shilling, the Chinese strategy to acquire technology is "a highly coordinated, systematic, strategic initiative which, left unchallenged, will result in transfer of specialty metals technology [to] China."

The Shipping Industry

In May 2005, the Deputy Under Secretary of Defense for Industrial Policy completed a *Global Shipbuilding Industrial Base Benchmarking Study* that examined the six largest private shipyards in the United States in comparison to the world's ten leading shipyards. The study found that the U.S. shipbuilding industry has improved significantly over the last five years. Yet significant technology gaps still exist in some U.S. shipyards, and shipbuilding designs need to be optimized for state-of-the-art military vessels. According to the study, one major hindrance to industry improvements is the lack of competition caused by a series of acquisitions that have led to a military shipbuilding duopoly of General Dynamics and Northrop Grumman.

For the first time in 50 years the United States is not currently developing a new submarine design. Amy Praeger of the American Shipbuilding Association testified that this has a devastating effect on the ability to ensure the continued availability of qualified ship design engineers. Since 1991, 24,000 engineers and production jobs have been lost in the United States. Additionally many skilled workers are leaving the shipbuilding industry because the sector does not have consistent and stable contracts. Should a need appear for new skilled employees, it could take 15 years to replicate the lost skill level.

Based on the testimony presented at the hearing, and its consequent findings, the Commission proposes the following recommendations to Congress to address the problems identified.

Recommendations

1. In order to maintain a strong U.S. technological base in key defense industries, the Commission recommends that Congress direct the Commerce Department to conduct a study to determine and recommend appropriate actions—in areas such as tax policy, energy policy, etc.—to promote domestic research, development, and production in defense-related industries.

2. Given DoD's reliance on civilian technology companies and the evidence of a disconnect between civilian R&D and U.S. defense technology and research needs, the Commission reiterates the recommendations it made in the record of its hearing on Chinese high technology development (that the Commission conducted on April 21 and 22, 2005 in Palo Alto, California) that the Congress (1) provide for development of a coordinated, comprehensive, national technology competitiveness strategy designed to meet China's challenge to U.S. scientific and technological leadership; and (2) establish a task force including representatives from the Office of Science and Technology Policy, the National Science Foundation, and the Departments of Education, Defense, State, Energy, Labor, and Commerce to consult on a regular basis with private-sector leaders in key science and technology industries, and investment leaders, particularly venture capitalists, regarding development and implementation of the national strategy. The intent in initiating such a task force is to create a permanent structured dialogue between the Federal Government and the private sector about technology base issues that have a direct effect on U.S. economic and national security. The task force should be required to report its findings and recommendations to Congress on an annual basis.

3. In response to the evidence that China is pursuing a national strategy of corporate acquisition in key sectors of significance to the national defense, the Commission recommends that Congress direct the President's National Economic Council to prepare and submit the quadrennial reviews of strategies by foreign countries and companies to acquire U.S. critical technology industries that are required by law, but that have been neither prepared nor delivered since the first report was delivered to the public in 1994.

4. With China pursuing a coordinated strategy to attract investment in the semiconductor industry and in light of the extreme importance and urgency of ensuring a secure domestic supply of high-performance microchips for U.S. defense needs, the Commission recommends that Congress direct DoD to prepare an assessment of its future microchip needs and establish a carefully designed acquisition program based on that assessment that will secure a sufficient number of "trusted and assured sources" of integrated circuits.
5. The Commission recommends that Congress direct DoD to prepare an assessment of China's anticipated naval buildup over the next decade and its stated plans to source 100 percent of the necessary systems and components required for this buildup. In order to usefully compare China's planned naval capability to U.S. naval capability, this assessment also should identify the ships, and the ship components and systems, that will be needed to meet U.S. military requirements over the next 20 years and the projected sourcing plan for all required ships, components, and systems extending to all levels of manufacturers and suppliers—specifically noting anticipated sourcing dependence on China. This exercise should provide a prognosis of the long-term viability of U.S. domestic manufacturers of ships, components, and systems needed to meet the requirements, and the critical industrial skill base those manufacturers will need—and should highlight anticipated problem areas.

Sincerely,

C. Richard D'Amato
Chairman

Roger W. Robinson, Jr.
Vice Chairman

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U.S.-CHINA TRADE IMPACTS ON THE U.S. DEFENSE INDUSTRIAL BASE

THURSDAY, JUNE 23, 2005

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION,
Washington, D.C.

The Commission met in Room 124, Dirksen Senate Office Building, Washington, D.C. at 9:30 a.m., Chairman C. Richard D'Amato, Vice Chairman Roger W. Robinson, Jr., and Commissioners Michael Wessel, William Reinsch, and Larry M. Wortzel (Hearing Co-chairs), presiding.

OPENING STATEMENT OF CHAIRMAN C. RICHARD D'AMATO

Chairman D'AMATO. The hearing will come to order. We are actually awaiting the arrival of Congressman Manzullo, and while we are waiting, we will take this time to give our opening statements on the hearing. Good morning and welcome. Today's hearing will address the issue of U.S.-China trade impacts on the U.S. defense industrial base. We're honored to have Congressman Manzullo speaking before us this morning.

This hearing follows two important field hearings the Commission recently held. In April, the Commission went to Palo Alto, California to Stanford University and heard testimony from former Secretary of Defense William Perry and high-tech industry leaders on the status of U.S. innovation and the impact of China's high-technology development on U.S. research and development sector.

This was followed by a hearing in May in New York City at the Council on Foreign Relations where the Commission heard from a distinguished group of economists on the effects of globalization on the U.S. economy.

Needless to say, these issues represent huge impacts on the U.S. economy, and it is the U.S. economy that is the heart of our national security and the U.S. defense sector.

This issue is particularly timely since Congress has recently reviewed the "Buy American" provision of our laws. The original "Buy American Act" and Berry Amendment established certain requirements for government entities including DoD to use U.S. sources whenever possible.

The requirement is waived when it is not deemed effective to use a U.S. source. Some legislators believe that the waiver process by which DoD is circumventing the Buy American provision has been used arbitrarily.

The health of the defense industrial base is not only measured by the level of Defense Department reliance on foreign sourcing, but is generally caught in and affected by the process of globaliza-

tion itself. We will hear views today on the effects of globalization on the U.S. defense industrial base.

But regardless of the level of globalization different experts find appropriate, for the defense industrial base to benefit from globalization, there must be a level playing field for trade and a protection from piracy.

The Commission has found in its 2002 and 2004 reports that China poses challenges on both accounts and it is for this reason that we must examine this issue today.

I look forward to today's hearing and testimony and I will now turn over the podium to our Vice Chairman Roger Robinson.

[The statement follows:]

Prepared Statement of Chairman C. Richard D'Amato

Good morning and welcome. Today's hearing will address the issue of U.S.-China trade impacts on the U.S. defense industrial base. We are honored to have Congressman Manzullo speaking before us this morning. I want to thank him for taking the time to be here.

This hearing follows two important field hearings the Commission recently held. In April the Commission went to Stanford University, in Palo Alto, CA to hear testimony from former Secretary of Defense William Perry and high-tech industry leaders on the status of U.S. innovation and the impact of China's high-technology development on the U.S. research and development sector. This was followed by a hearing in May in New York City at the Council on Foreign Relations where the Commission heard from a distinguished group of economists on the effects of globalization on the U.S. economy. Needless to say, these issues represent huge impacts on the U.S. economy. And it is the U.S. economy that is the heart of our national security and the U.S. defense sector.

This issue is particularly timely, as Congress has recently reviewed the "Buy American" provisions of our laws. The original "Buy American Act" and Berry Amendment, established certain requirements for government entities, including DoD, to use U.S. sources when possible. The requirement is waived when it is not deemed effective to use a U.S. source. Some legislators believe that the waiver process by which DoD is circumventing the Buy American provision is used arbitrarily. I anticipate Congressman Manzullo will address this issue later today.

The health of the defense industrial base is not only measured by the level of Defense Department reliance on foreign sourcing, but is generally caught in and affected by the process of globalization itself. We will hear views today on the effects of globalization on the U.S. defense industrial base. But regardless of the level of globalization different experts find appropriate, for the defense industrial base to benefit from globalization, there must be a level playing field for trade and a protection from piracy. The Commission has found in both its 2002 and 2004 report that China poses challenges on both accounts and it is for that reason that we must examine this issue today.

I look forward to today's testimony and will now turn to the Commission Vice Chairman Roger Robinson.

OPENING STATEMENT OF VICE CHAIRMAN ROGER W. ROBINSON, JR.

Vice Chairman ROBINSON. Thank you, Mr. Chairman. I join the chairman in my appreciation to Congressman Manzullo who is going to be with us shortly for his willingness to testify today. I also look forward to this morning's presentations by the Honorable Peter Lichtenbaum and Dr. William Schneider.

We have a lot of ground to cover today so I would like to focus on one issue of concern. We are, of course, discussing U.S.-China trade and the impact of that bilateral trade on our defense industrial base, but it also seems to me that Chinese investments abroad are a legitimate subject of interest. When Chinese companies that are majority owned by the government acquire companies either in

the U.S. or elsewhere in sectors that are critical to the U.S. Department of Defense or are militarily sensitive that should concern us.

It's no secret that China is looking to buy up resources from many quarters, not just oil or natural gas, but also materials such as titanium. The Chinese are no doubt securing these supplies for their own commercial and strategic needs, but what happens to our access to some of these critical resources that China is seeking to, in effect, lock up should there be, for example, heightened tensions with Beijing down the road?

Moreover, China also seems interested in U.S. and other global technology companies. It strikes me that acquiring technology companies is a much more efficient means of gaining access to a wealth of technological knowledge and management than the type of technology transfers that China would require from global companies, for example, investing in China.

I hope we'll have an opportunity today to treat these issues, and I'd now like to turn over the proceedings to Commissioner Reinsch who is co-chairing today's hearing.

[The statement follows:]

Prepared Statement of Vice Chairman Roger W. Robinson, Jr.

I join the Chairman in my appreciation to Congressman Manzullo for taking the time to be here. I also look forward to this morning's presentations by the Honorable Peter Lichtenbaum and Dr. William Schneider.

We have a lot of ground to cover today, so I'd like to focus on one issue of concern. We are of course discussing U.S.-China trade and the impacts that has on our defense industrial base, but it also seems to me that Chinese investments abroad are a legitimate subject of interest as well. When Chinese companies that are majority owned by the Chinese government acquire companies either in the U.S. or elsewhere in sectors that are critical to the Defense Department or militarily sensitive, that should concern us. It is no secret that China is looking to buy up resources from many quarters, not just oil or natural gas, but also materials such as titanium. The Chinese are no doubt securing these supplies for their own commercial and strategic needs, but what happens to our access to some of these critical resources that China is seeking to, in effect, lock up should there be heightened tensions with Beijing down the road?

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I hope we'll have an opportunity today to treat these issues. Now let me turn the proceedings over to Commissioner Reinsch.

Chairman D'AMATO. Mr. Vice Chairman, Commissioner Reinsch, I think what we might want to do is defer for a moment prior to Congressman Manzullo unless you have a statement you would like to make right now.

[Recess.]

Chairman D'AMATO. The hearing will resume and be called to order.

OPENING STATEMENT OF COMMISSIONER WILLIAM A. REINSCH HEARING COCHAIR

Cochair REINSCH. Thank you. The issue that we're discussing today, the defense industrial base and any impact U.S.-China trade and investment may have on it, is an important issue and a complex one. The technologies that lay the groundwork for 21st century

defense structure are at the core of what we're going to be talking about.

Integrated circuits, information technology, composite materials, among others, are all integral to the function of the U.S. military. They are also all increasingly reliant on commercial forces for their development. These commercial forces, in turn, are caught up in globalization. It is the task of the government not to hinder those forces, but rather to balance the benefits of the defense sector that globalization provides while ensuring a secure supply of critical U.S. defense needs.

Today, we're really honored to have with us Congressman Don Manzullo of Illinois, Chairman of the House Small Business Committee. The health of U.S. industries as they relate to national security is a key issue for Congress, and we look forward to his statement. Mr. Manzullo was first elected to Congress in 1992 from a district near where I grew up in northern Illinois.

It's a manufacturing center. He has been a hero for a long time to smaller manufacturers and certainly a hero in the export control community for the many thoughtful and sensible things he has said for a many years. Lately, he's had a lot more to say about China, and that's why he's here today and we're happy to have him.

Following him, we are also particularly pleased to have the Acting Under Secretary of Commerce for Industry and Security, the Honorable Peter Lichtenbaum. Mr. Lichtenbaum is in charge of the Commerce Department's Bureau of Industry and Security, a very important position in the government I might add. Which seeks to advance U.S. national security, foreign policy and economic interests. BIS oversees issues at the intersection of business and national security including strategic trade controls, imports, and foreign acquisitions that affect U.S. security, enforcement of anti-boycott laws and industry compliance with international arms control agreements.

In his capacity as Assistant Secretary, Mr. Lichtenbaum is responsible for developing BIS' policies regarding controls on the export of dual-use items for national security, foreign policy, nonproliferation and short supply reasons. We're particularly grateful to him for his appearance today in part because the Defense Department unfortunately has declined to appear, and we are disappointed in that. It's hard to have a complete hearing about the defense industrial base when the people who have such a critical role in utilizing it are not here. We hope to get them at another time, and as one of my neighbors said about her three-year-old son, "We will speak firmly to them later on." Let me say, though, that we've asked Acting Under Secretary Lichtenbaum to come to deal with issues that are within his purview as the head of his bureau, and he's going to discuss the challenges for U.S. dual-use export control policy with respect to China, the types of U.S. export controls aimed at prohibiting the export of sensitive items and technology, particularly with respect to aerospace and semiconductors, and BIS' role in analyzing industry sectors identified by the Department of Defense.

It's generous of Mr. Lichtenbaum to agree to come, and I hope the Commissioners will confine their questions to those topics.

Let's proceed now with Congressman Manzullo, and welcome.

[The statement follows:]

Prepared Statement of Commissioner William A. Reinsch
Hearing Cochair

The issue we are discussing today—the defense industrial base and any impact U.S.-China trade and investment may have on it—is important and complex. The technologies that lay the groundwork for a 21st century defense structure are at the core of this discussion. Integrated circuits, information technology, composite materials are all integral to the function of the U.S. military; they are also all reliant on commercial forces for their development. These commercial forces are moved by the current state of globalization. It is the job of the U.S. Government not to hinder these forces, but to rather, balance the benefits to the defense sector that globalization provides, while ensuring a secure supply of critical U.S. defense needs.

Today we are honored to have with us Congressman Manzullo of Illinois, Chairman of the House Small Business Committee. The health of U.S. industries as they relate to national security is a key issue for Congress and we look forward to his statement. I thank Congressman Manzullo for taking the time to dialogue with us today.

We are also pleased to have the Acting Under Secretary of Commerce for Industry and Security, the Honorable Peter Lichtenbaum. Mr. Lichtenbaum is in charge of the Commerce Department's Bureau of Industry and Security (BIS), which seeks to advance U.S. national security, foreign policy, and economic interests. BIS oversees issues at the intersection of business and national security, including strategic trade controls, imports and foreign acquisitions that affect U.S. security, enforcement of antiboycott laws, and industry compliance with international arms control agreements. In his capacity as Assistant Secretary, Mr. Lichtenbaum is responsible for developing BIS's policies regarding controls on the export of dual-use items for national security, foreign policy, nonproliferation, and short supply reasons. I thank you for taking the time to be here today.

Both the Honorable Kenneth Krieg, Under Secretary of Defense for Acquisitions, Technology and Logistics, and the Honorable Suzanne Patrick, Deputy Under Secretary of Defense for Industrial Policy were unable to attend today's hearing due to scheduling conflicts. As such, we will hold off any defense questions for a followup paper the Defense Department will provide to the Commission. Mr. Lichtenbaum will discuss three issues: (1) the challenges for U.S. dual-use export control policy with respect to China, (2) the types of U.S. export controls aimed at prohibiting the export of sensitive items and technology, particularly with respect to aerospace and semiconductor sectors, and (3) the Bureau of Industry and Security's role in analyzing industry sectors identified by the Department of Defense.

With that, let's begin with Congressman Manzullo.

PANEL I: CONGRESSIONAL PERSPECTIVES

STATEMENT OF DONALD A. MANZULLO
A U.S. REPRESENTATIVE FROM THE STATE OF ILLINOIS AND CHAIRMAN, COMMITTEE ON SMALL BUSINESS

Congressman MANZULLO. Thank you very much. Let me lobby Peter Lichtenbaum while he's here because it really shows the extent of the problem. Peter, you can write this down. Gleason-Pfauter is located in my congressional district. They are one of the world's premier manufacturers of machine tools for gears. They make all kinds of gears—Falk up in Milwaukee, which is big gears, down to small gears. They've just been given notice by the Department of Commerce that—and I told them I would talk to Peter so I could do it openly here—the machine tool they're making is too sophisticated to sell to China.

Now, this is a bread-and-butter machine. You can buy it in Canada. You can buy it in Europe. You can buy it in Japan. But because our government thinks it's too sophisticated, we should not sell it to China. Now, this is dumb. The Chinese won't come and buy our machine tools. People from Tier III countries won't come

here, and so what happens is Gleason-Pfauter will say, we'll just move everything overseas, possibly China.

One of the biggest problems that we have with our deficit is caused by our own stupid policies. It's one thing after the other, and so we're going to be meeting with the people from Gleason-Pfauter, and we've already talked to Peter about it here openly. But I just wanted to share that because here's something that we can do immediately to narrow that gap.

The second thing is on visas. Our government thinks that every Chinese, especially those with engineering degrees, are terrorists. We can't bring them here. Our Small Business Committee just negotiated a yearly multi-entry visa to pre-qualify—a trusted traveler—the Chinese, so they come here and buy our stuff, and most of the stuff was uncontrolled. It's four-axis and under.

And, likewise, with the Memorandum of Agreement. But these are policies that are going on right now within the government that could be changed overnight that would allow a lot more money to come in and would go greatly to reduce the trade deficit. I'll get on to my opening statement. Peter, thank you for your open ear, but you didn't have much choice.

Chairman D'Amato, distinguished Commissioners, thank you for the opportunity to testify before you to discuss the emergence of China as a global manufacturing superpower and its impact on America's ability to innovate. This is extremely timely and critical for policy leaders here in Washington as the rise of China directly impacts the current health and future vitality of the U.S. industrial base, upon which we all depend for security, livelihood and future ability to lead.

We all know the ascent of Chinese exports continues to grow. In particular, China's merchandise trade surplus with U.S. now far exceeds Japan's and the torrid rate of growth has continued into this year.

This unprecedented growth in exports is a direct reflection of the rise of China as the world leader in manufacturing. We can debate whether this rise in manufacturing muscle is due primarily to low wages, unfair trading practices, such as the current government's policy of undervaluing its currency, and appropriating intellectual property, or the 22.4 percent structural cost disadvantage that American manufacturing must endure to do business in the U.S.

In fact, I believe that all of these issues have directly supported China's rise as a manufacturing superpower, but what cannot be debated is the fact that China has become a manufacturing superpower. What does this mean for American manufacturing and those few policymakers in Congress that care about American manufacturing?

As one of the few Members of Congress deeply interested in American manufacturing, I've crisscrossed the country, visited hundreds of factories. As chairman of the House Small Business Committee, I've held over 60 hearings addressing manufacturing concerns, and I want to share these with you today some of my thoughts and findings about the relationship between manufacturing and innovation.

The purpose of my talk is to spark a dialogue about our national strength. At the end of World War II, General George Marshall

said we're now concerned with the peace of the entire world, and the peace can only be maintained by the strong. Here are some questions we have to ask ourselves.

What does it mean for Americans if we lose our ability to innovate in this country?

Can strength be defined within the limits of financial prowess or does the ability to make things matter?

How important is it to maintain manufacturing in this country? Chairman Greenspan doesn't think it's important at all. He said that. He said we could go to a service economy, lose our manufacturing base, and the manufacturing jobs would be subsumed by high value/high-ended white-collar jobs. You ask him what one of those is, and the time runs out on the buzzer.

Do we really need to build anything anymore here in America to maintain our innovation capacity?

The defense industrial base, which is a subset of our overall industrial base, is an element of our national power—the sum total of our country's ability to use our power to shape world events and ultimately implement our national security strategy.

In past years, DoD was a major driver of technological advances with the manufacturing. I'm very sorry that DoD didn't accept your invitation to testify today. Bill, can I ask you who it was you invited from DoD to come and who refused? Get their name on record.

Cochair REINSCH. Yes. Kenneth Krieg, the Under Secretary of Defense for Acquisitions, Technology, and Logistics, and Suzanne Patrick, the Deputy Under Secretary for Industrial Policy.

Congressman MANZULLO. And they both were invited? I thought Suzanne had left.

Chairman D'AMATO. They're both traveling.

Congressman MANZULLO. Oh, they're both traveling. Did they send testimony?

Chairman D'AMATO. No, they did not.

Congressman MANZULLO. Okay.

Cochair WESSEL. We also offered the opportunity for someone in their office to testify as well.

Congressman MANZULLO. I think that should go to show the indifference that the Pentagon has towards maintaining our defense industrial base.

So often we hear about the need to maintain broad free-trade principles in an unconstrained global engagement. I certainly count myself as a free trader. In fact, I'll put my free-trade credentials up against any Member of Congress. Some people think I'm against free trade, but as the President has said on numerous occasions, trade must be both free and fair.

That is why there is such a sour mood regarding trade in Congress right now. Congress has become deeply concerned, some would say fixated, on trade issues with China and the lack of meaningful progress to resolve the issues of currency manipulation, intellectual property rights, and other free trade barriers enacted by the Chinese.

Right now there are many bills and resolutions pending in Congress about some or all of these issues. Phil English wants to treat China as if it was a market economy for purposes of imposing coun-

tervailing duties, and that's a first step. And some in the Senate have called for 27.5 percent blanket tariff upon Chinese imports. That's not a good idea, but Senator Schumer says he hates his own bill and doesn't want to see it implemented anyway. In fact, he said that a year ago when we sat at this table together.

All this activity squarely reflects the growing frustration and sense of unease about China's emergence. It is no wonder that many here in Congress believe that discussion of further free trade agreements, such as DR–CAFTA, are premature and should be put on hold until the Administration gets tough with China.

Clearly, here at home, we have some fundamental problems to deal with such as overhauling the Tax Code, ending lawsuit abuse, enacting sound energy policies, lowering the cost of health care by allowing small companies to band together, et cetera.

But this is not enough. Consider the following: growth in U.S. manufacturing activity slowed in May for the sixth consecutive month, while factory employment failed to improve for the first time in 19 months according to data from the Institute for Supply Management on the survey released on June 1.

The rate of increase of new orders continues to decelerate with only 11 of 20 industries reporting gains in new orders in May. And growth in exports has also continued to erode since at least this past February.

Productivity. Whenever there is a discussion over the erosion of manufacturing, inevitably productivity is mentioned as a major reason for the loss of jobs. Theoretically, high productivity means it costs less to make the same unit today than it did yesterday.

We tend to attribute that to greater use of technology. In reality, what's reported quarterly as sectoral output productivity does not capture the cost of business inputs. So the fact that your unit costs are lower doesn't mean you're more productive because of capital equipment or improved business process; it simply means you found a cheaper way to get that done and more often than not, it's by offshoring the work, including high-end work, or importing cheaper parts.

Let's talk about defense procurement. My position on Buy America—I've found that many people simply don't understand the significance. When the Buy American law was passed in the 1930s, it said all or substantially all of a product had to be made in the United States, subsequently refined by regulation that said all or substantially all means more than 50 percent. 1979 under one of the Trade Agreement Acts, it said that essentially if you buy from any of the 30 or so countries that are signatories to that, it's the same as buying from America, and then memoranda of understanding, executed by the Defense Department and foreign countries without the consent of Congress said if you buy from any of 23 countries listed in the memorandums of understanding, that means that it's the same as buying from America; so therefore complete compliance with the Buy American Act can result in zero American parts.

Oh, and by the way, that law doesn't apply if you want to buy something that's not made in America; obviously you can buy it offshore. But there's been so much misunderstanding on that, that I just wanted to bring that up.

In addition, while the Commerce Department continues to fight unfair subsidies around the world, like those in Boeing versus Airbus, so that our companies can compete fairly, the Pentagon—thank you for showing up today—continues to rush to award contracts to foreign companies or their American partners that are subsidized or effectively controlled by their foreign governments.

Take AgustaWestland, for example. That's the one along with an American partner got the Marine One contract. That company is owned by the Italian government, which has three of the board seats with one of those being the treasurer of the country, and it is controlled and subsidized by the Italian government.

The Pentagon sees no problem with having our market-based companies compete against those that have the support of their government all in the name of, quote "best value."

Keep in mind that AgustaWestland is also helping the Chinese develop first-class helicopter technology.

Engineers. We see the migration of our innovation capital in a number of disturbing trends. An area not often thought of when discussing innovation is the challenge engineers are having. The unemployment rate continues to be at historical highs.

Electrical engineers, for example, are seeing an unemployment rate of roughly seven percent, three times the norm. Deans at respected engineering universities are finding fewer students entering this discipline, and why is this significant? According to a study published by the National Science Foundation, 46 percent of our engineers are employed in the manufacturing sector.

As that sector shrinks, more engineers become unemployed. Students see this trend and decide to study something else with hopefully a longer future. And fathers who are engineers, who have had their jobs outsourced to Pakistan or to India and China, tell their kids not go to into engineering because they're not sure if they are going to have a job.

Semiconductors. Another good example of the decline of innovation capacity is reflected in the semiconductor industry. Semiconductor foundries are manufacturing facilities that produce semiconductors from designs provided by other companies. Most of these high-tech foundries are now being located outside the U.S. And why?

Many governments view semiconductor foundries as a matter of critical national security and intense national interest. Israel, Taiwan, Singapore and most notably China through its National Academy of Sciences, have been extremely aggressive about providing massive government support and often outright subsidies to convince established companies and start-ups alike to build semiconductor foundries in their countries.

The latest ploy by the Chinese is to give grants of R&D money to Chinese semiconductor firms. They are not doing this to be charitable. They recognize that having the manufacturing on their soil creates a virtual cycle of jobs, small business opportunities and innovation for their people.

These are good, often great, jobs for the locals. These governments understand. They know that proximity accelerates tech transfer from lab to fab. The presence of fabrication facilities sup-

ports the research university base and students benefit greatly from access to industry facilities.

One prominent international trade expert who testified at one of my hearings last summer told us this:

The "foundries have enabled host countries to dramatically enhance competencies in semiconductor manufacturing, to build capability in integrated circuit design, to attract foreign investment and technology, and ultimately to draw in semiconductor infrastructural enterprises"—that's "makers of production equipment and materials, and providers of logistics and other services"—"as well as talented individuals."

As we examine these trends and issues, I think we can only conclude one thing: America is at risk of losing its innovation lead in the world. These concerns were underscored by the National Association of Manufacturers, which concluded the following:

U.S. manufacturing's innovation process leads to investments in equipment and people to productivity gains, to beneficial spillovers, and to new and improved products and processes. This intricate process generates economic growth and higher living standards superior to any other economic sector. But serious challenges do threaten to undermine the critical mass of manufacturing necessary to maintain a dynamic innovation process in the United States.

If the U.S. manufacturing base continues to shrink at its present rate and the critical mass is lost, the manufacturing innovation process will shift to other global centers. Once that happens, a decline in living standards in the U.S. in the future is virtually assured.

This is not a protectionist organization. This is the National Association for Manufacturers.

Kissinger said that, "if outsourcing continues to strip the U.S. of its industrial base and the act of getting out or developing its own technology, then we require a careful thought on national policy."

"The question is whether America can remain a great or dominant power if it becomes a pure service economy," Kissinger added. "I doubt it very much. I think that a country has to have a massive industrial base in order to play a significant role in the world."

If we lose our manufacturing capability, America will still survive, but will we still be able to lead and, as Kissinger puts it, "play a significant role in the world?"

Where I really think these issues become critically important is in respect of our ability to protect ourselves. Over the years, DoD has become much more reliant on the private sector. Recently, President Bush noted in a major report that the defense industrial base is a key asset that has become vulnerable.

His report states: "Because of market competition and attrition, DoD now relies more and more on a single or very limited number of private-sector suppliers to fulfill some of its most essential needs."

"Most often the procurement process is based on cost and efficiency. Such an approach may not always take into consideration the vendor's critical infrastructure protection practices, for example, the supplier base, and its ability to supply products and serv-

ices and provide surge response during an emergency or exigent circumstance."

Recently I was appointed to the Steering Committee for the National Innovation Initiative as part of the Council on Competitiveness, and I want to commend the Council and IBM for driving this dialogue and the good work they're doing in trying to keep a lot of manufacturing here in the United States.

Manufacturing is, indeed, the core of our nation's strength. With a strong manufacturing base comes engineering, R&D and innovation. If we only look at the cost and determine that another country can do all these things cheaper, then we limit our strength and the speed of our innovation cycles to that of those nations.

Do we really want to race to the bottom? At what point has so much technology and manufacturing skill left the U.S. that we become too reliant on foreign suppliers for the core components of our defense manufacturing capabilities?

So what do we do about it? We strengthen America. I personally find these trend lines very disturbing. I think that policymakers in Washington need to start addressing focused public policy response to them, and here is what I'm doing:

Number one, I propose that we strengthen America. As you know, the government and particularly DoD are among the biggest customers in the world. Using taxpayer money to support important public policy goals is a well-established doctrine and Federal procurement law. And Adam Smith said it's even exempt from the "wealth of nations" and the doctrines of laissez-faire.

We have guidelines to direct procurement dollars to assist small businesses, for women-owned businesses, and for Native American businesses. I think it's a good idea that we use some of that taxpayer money to support innovation in this country.

In pursuit of strengthening our industrial capacity, we should focus our procurement dollars to preserve American innovation by using the taxpayer's money to support the growth and development of innovative new technologies in the procurement process.

No one has any interest in denying the war fighter the best technology at the best price to undertake their mission. This is and never was the result or intent behind Buy America.

Instead we should refocus our purchasing priorities. If there are good, value-based reasons to buy commodities and commercial end items on the open market, I'm not too concerned about that, although I have to ask are we really prepared to buy all of our bullets from the Chinese?

Two, we must reform our visa process which is hurting our ability to sell goods to foreign customers. They can't come here to inspect or buy our stuff.

Third, we must reform the CFIUS process to consider economic security as part of national security.

We do that by expanding the focus beyond narrow traditional national security concerns in CFIUS to encompass economic security. The reason is because the rise of China demonstrates that the loss of key manufacturing assets quickly dissolves into a question of national security. If we no longer possess the capability to defend ourselves, how can we maintain our role as the arsenal of democracy?

We must drive transparency and accountability into the CFIUS review mechanism. Currently, although both the law and implementing regulations require that decisionmakers consult with Congress, that obligation has been ignored by the Treasury Department. I base this conclusion upon my personal experience with Treasury officials during the course of our inquiry into the IBM/Lenovo acquisition.

Based on the above, I have to ask myself if the Treasury Department is still the appropriate place to handle the CFIUS reviews? It seems to me that the Treasury Department has yet to see a foreign acquisition that it didn't like. I think it's time that the CFIUS process was administered by the Commerce Department, which already looks at industrial security issues.

Let me end with this. Now, a Chinese state-owned industry—call it the Chinese government—is in the process of buying up the fifth largest energy company in the world. That's Unocal Corporation.

What's important about this transaction is this: CNOOC is a state-owned enterprise. This is the Chinese government. What does that mean? Countervailing duties cannot be imposed against them. In my district, we have a little plant in Hanover, Illinois that makes thermo-couplers for Maytag. Well, Maytag is being bought by the Chinese government and they want to move production there. What does that do? Well, when production is in Mexico, at least the parts come from here and go to Mexico.

Mexico has lost 20 percent of its maquiladoras. Mexico loses $1 billion a year in shipping textiles to the United States because it's all going to China. So the source of the raw materials that normally comes from the United States, that's also drying up.

I want to thank you for the opportunity to testify here on these important issues, and I look forward to answering any questions that you may have.

You can tell I do have opinions on these issues.

[The statement follows:]

Prepared Statement of Donald A. Manzullo
A U.S. Representative from the State of Illinois and
Chairman, Committee on Small Business

"Manufacturing Dragon: China's Emerging Role as a Global Factory and Its Implications for American Innovation"

Chairman D'Amato, distinguished Commissioners and ladies and gentlemen, thank you for this opportunity to discuss the emergence of China as a global manufacturing superpower and its impact upon America's ability to innovate.

This inquiry is extremely timely and critical for policy leaders here in Washington, as the rise of China directly impacts the current health and future vitality of the U.S. industrial base upon which we all depend for our security, our livelihood and our future.

We all know that the ascent of Chinese exports continues to grow. In particular, China's merchandise trade surplus with the U.S. now far exceeds Japan's, and the torrid rate of growth has continued into 2005.

This unprecedented growth in exports is a direct reflection of the rise of China as the world leader in manufacturing. We can debate whether this rise in manufacturing muscle is due primarily to low wages, unfair trading practices (such as the current government's policy of undervaluing its currency and appropriating intellectual property), or the 22.4 percent structural cost disadvantage that American manufacturing must endure to do business in the U.S.

In fact I believe that all of these issues have directly supported China's rise as a manufacturing superpower. But what cannot be debated is the fact that China has become a manufacturing superpower. What does this mean for American manufac-

turing and those few policymakers in Congress that care about American manufacturing?

As one of the few Members of Congress deeply interested in American manufacturing, I have criss-crossed this country and visited hundreds of factories. As Chairman of the House Small Business Committee, I have held over 60 hearings addressing these concerns. I want to share with you today some of my thoughts and my findings about the relationship between manufacturing and innovation. The purpose of my talk is to spark a dialogue about our national strength.

At the end of World War II, General George C. Marshall said, "We are now concerned with the peace of the entire world, and the peace can only be maintained by the strong."

Here are some questions we need to ask ourselves:

- What does it mean for Americans if we lose our ability to innovate in this country?
- Can strength be defined within the limits of financial prowess or does the ability to make things matter?
- How important is it to maintain manufacturing in this country?
- Do we really need to build anything anymore here in America to maintain our innovation capacity?

The defense industrial base, which is a subset of our overall industrial base, is an element of our national power—the sum total of our country's ability to use our power to shape world events, and ultimately, implement our National Security Strategy. In past years, DoD was a major driver of technological advances within manufacturing. Today, they have become mere purchasers of whatever comes off the shelf; pawns of a commercial industry that's driven by the bottom line as opposed to national security.

So often we hear about the need to maintain broad, free trade principles and an unconstrained global engagement, and I certainly count myself as a free trader. In fact, I will put my free trade credentials up against any Member of Congress. Some people think I am against free trade, but as the President has said on numerous occasions, trade must be both free and fair.

This is why there is such a sour mood regarding trade in the Congress right now. Congress has become deeply concerned, some would say fixated, on trade issues with China and the lack of meaningful progress to resolve the issues of currency manipulation, intellectual property rights and other free trade barriers enacted by the Chinese. Right now there are many bills and resolutions pending in Congress that address some, or all of these issues. Mr. English wants to treat China as if it were a market economy for purposes of imposing countervailing duties. And some in the Senate have called for a 27.5 percent blanket tariff upon Chinese imports.

All this activity squarely reflects the growing frustration and sense of unease about China's emergence. It is no wonder that many here in Congress believe that discussion of further free trade agreements, such as DR–CAFTA, are premature and should be put on hold until the Administration gets tough with China.

Clearly, here at home we have some fundamental problems to deal with, such as overhauling the Tax Code, ending lawsuit abuse, enacting sound energy policies, and lowering the cost of health care by allowing small companies to band together and purchase medical care at a lower insurance cost.

But this is not enough. Consider the following:

- Growth in U.S. manufacturing activity slowed in May for the sixth consecutive month, while factory employment failed to improve for the first time in 18 months, according to data from the Institute for Supply management. Survey released June 1.
- The rate of increase in new orders continued to decelerate, with only 11 of 20 industries reporting gains in new orders in May.
- Growth in exports has also continued to erode since at least February.

PRODUCTIVITY

Whenever there is a discussion over the erosion of manufacturing, inevitably productivity is mentioned as a major reason for the loss of jobs. Theoretically, higher productivity means it costs less to make the same unit today than it did yesterday. We tend to attribute that to greater use of technology. In reality, what's reported quarterly as sectoral output productivity doesn't capture the cost of business inputs. So the fact that your unit costs are lower, doesn't mean you're more productive because of capital equipment or improved business process. It simply means you've found a cheaper way to get that work done. More often than not, it's by offshoring the work, including high-end work.

DEFENSE PROCUREMENT

You all know of my position on Buy America. I have found that many people simply don't understand the significance. The current law as applied to DoD allows the Secretary to bypass buying anything in the U.S. as long as a qualifying country can produce the item(s). The list of countries eligible for such status stands at 21, but there are other types of waivers through source of supply agreements and the balance of payments program that elevate that number to 45. That means that the Pentagon or one of its contractors can claim compliance with BAA without actually having to buy anything in the U.S.

In addition, while the Commerce Department continues to fight unfair subsidies around the world, like those in the Boeing v. Airbus debate, so that our companies can compete fairly, the Pentagon rushes to award contracts to foreign companies (or their American partner) that are subsidized or effectively controlled by their foreign governments. Take AgustaWestland, for example. That company is owned by the Italian government, has three of the board seats (with one of those being the treasurer of the country), and is controlled and subsidized by the government. The Pentagon sees no problem having our market-based companies compete against those that have the support of their government—all in the name of "best value." Keep in mind that AgustaWestland is also helping the Chinese develop first-class helicopter technology.

ENGINEERS

We see the migration of our "innovation capital" in a number of disturbing trends.

An area not often thought of when discussing innovation is the challenge engineers are having. The unemployment rate continues to be at historical highs. Electrical engineers, for example, are seeing an unemployment rate of roughly 7 percent, three times the norm. Deans at respected engineering universities are finding fewer students entering this discipline. Why is this significant? According to a study published by the National Science Foundation, 46 percent of our engineers are employed in the manufacturing sector. As that sector shrinks, more engineers become unemployed. Students see this trend and decide to study something else with, hopefully, a longer future.

For example, don't be fooled into thinking that all 25,000 jobs that will be eliminated over the next three years at GM are all factory floor people. GM has a nicely automated manufacturing plant in Shanghai with a 900-person state-of-the-art R&D center, with plans on designing, building, manufacturing, and exporting vehicles to North America by 2007. You can bet that while they are losing people in the U.S., GM is not losing capability.

Semiconductor Industry

Another good example of the decline in our innovation capacity is reflected in the semiconductor industry. Semiconductor foundries are manufacturing facilities that produce semiconductors from designs provided by other companies. Most of these high tech foundries are now being located outside the U.S.—Why?

Many governments view semiconductor foundries as a matter of critical national security—and intense national interest. Israel, Taiwan, Singapore—and most notably, China through its National Academy of Sciences—have been extremely aggressive about providing massive government support—and often out-right subsidies, to convince established companies and start-ups alike to build semiconductor foundries in their countries.

The latest ploy by the Chinese is to give "grants" of R&D money to Chinese semiconductor firms. They are not doing this to be charitable! They recognize **that having the manufacturing on their soil creates a "virtual cycle" of jobs, small business opportunity and innovation for their people**.

These are good, often great jobs for the locals; these governments understand that. They know that proximity accelerates tech transfer "from lab to fab." The presence of fabrication facilities supports the research university base, and students' benefit greatly from access to industry facilities. One prominent international trade expert who testified at one of my hearings last summer told us this:

> The "foundries have enabled host countries to dramatically enhance competencies in semiconductor manufacturing, to build capability in integrated circuit design, to attract foreign investment and technology, and ultimately to draw in semiconductor infrastructural enterprises (makers of production equipment and materials, and providers of logistics and other services) as well as talented individuals."

[Testimony of Thomas R. Howell, Dewey Ballentine, before the HSBC, 10/16/03].

What Do These Trend Lines Mean?

As we examine these trends and issues, I think we can only conclude one thing: America is at risk of losing its innovation lead in the world. These concerns were underscored by the National Association of Manufacturers, which concluded the following:

> U.S. Manufacturing's innovation process leads to investments in equipment and people, to productivity gains, to beneficial spillovers, and to new and improved products and processes. This intricate process generates economic growth and higher living standards superior to any other economic sector. But serious challenges threaten to undermine the critical mass of manufacturing necessary to maintain a dynamic innovation process.
>
> If the U.S. Manufacturing base continues to shrink at its present rate and the critical mass is lost, the manufacturing innovation process will shift to other global centers. Once that happens, a decline in U.S. living standards in the future is virtually assured.

This is an excerpt from a white paper produced for the National Association of Manufacturers in Spring 2003.

In 2003, former Secretary of State Henry Kissinger told a crowd of technology professionals that "if outsourcing continues to strip the U.S. of its industrial base and the act of getting out (developing) its own technology, then we require a careful thought on national policy."

He went on to say: "the question is whether America can remain a great or a dominant power if it becomes a [pure] service economy. I doubt it very much. I think that a country has to have a massive industrial base in order to play a significant role in the world."

If we lose our manufacturing capability, America will still survive, but will we still be able to lead and, as Kissinger puts it, "play a significant role in the world?" I think this is the critical question. Does America want to remain the global superpower or are we satisfied with being a large financial center?

Can We Defend Ourselves If We No Longer Innovate?

Where I really think these issues become critically important is in respects of our ability to protect ourselves. Over the years, the Department of Defense has become much more reliant on the private sector. Recently President Bush noted in a major report that the defense industrial base is a key asset that has become vulnerable. His report states:

> "Because of market competition and attrition, DoD now relies more and more on a single or very limited number of private-sector suppliers to fulfill some of its most essential needs." . . . "Most often the procurement process is based on cost and efficiency. Such an approach may not always take into account the vendor's critical infrastructure protection practices (e.g. Supplier base) and its ability to supply products and services and provide surge response during an emergency or exigent circumstance."

Recently I was appointed to the Steering Committee for the National Innovation initiative. I want to commend such organizations as the Council on Competitiveness and IBM for driving this dialogue, and the good work that their report represents. This group is made up of a very distinguished group of scholars and leaders, and they concluded that America's ability to innovate is being rapidly eroded by the ongoing and unparalleled loss of our manufacturing capacity. I commend their report, "Innovate America" for making some hard-hitting findings.

For example, they note "if U.S. production capabilities continue to shift to overseas locations, and our innovative design and R&D stages follow them offshore, the country will face a major national security problem. We need the most advanced technologies and best manufacturing facilities inside our borders."

Manufacturing is, indeed, the core of our nation's strength. With a strong manufacturing base comes engineering, R&D, and innovation. If we only look at the costs and determine that another country can do all those things cheaper, then we limit our strength and the speed of our innovation cycles to that of those nations. Do we really want a race to the bottom? At what point has so much technology and manufacturing skill left the U.S. that we become too reliant on foreign suppliers for the core components of our defense manufacturing capabilities?

So What Do We Do About It?—We Strengthen America!

I personally find these trend lines very disturbing. I think that policymakers in Washington need to start addressing a focused public policy response to them.

Here's what I am doing:

1. I propose that we "Strengthen America." As you know, the Government, and particularly the DoD, are among the biggest customers in the world. Using taxpayer money to support important public policy goals is a well-established doctrine in Federal procurement law. We have guidelines to direct procurement dollars to assist small businesses, from woman-owned businesses and from native-American businesses. I think it's a good idea to use some of that taxpayer money to support innovation in this country.

   In pursuit of strengthening our industrial capability, we should focus our procurement dollars to preserve American manufacturing innovation by using the taxpayer's money to support the growth and development of innovative new technologies through in the procurement process. No one has any interest in denying the war fighter the best technology at the best price to undertake their mission. This is, and never was the result or the intent behind Buy America.

   Instead, we should refocus our purchasing priorities. If there are good value-based reasons to buy commodities and commercial end items on the open market, I am not too concerned about that (although I have to ask are we really prepared to buy all our bullets from the Chinese?)
2. We must reform our visa process, which is hurting our ability to sell our goods to foreign customers. They can't get into the country to inspect or buy our stuff. Our Committee was instrumental in creating a one year, multi-entry visa with China. This allows Chinese business visitors to come meet with U.S. suppliers and inspect the goods before making a purchase. Without this, our suppliers were at a great disadvantage. We must do the same for those potential buyers Europe and India.
3. We must reform the CFIUS process to consider economic security as part of national security.
   a. Expand the focus beyond narrow traditional national security concerns to encompass economic security. The reason is because the rise of China demonstrates that the loss of key manufacturing assets quickly devolves into a question of national security. If we no longer possess the capability to defend ourselves how can we maintain our role as the arsenal of democracy.
   b. We must drive transparency and accountability into the CFIUS review mechanism. Currently, although, both the law and the implementing regulations require that the decisionmakers consult with Congress, that obligation is being ignored by the Treasury Department. I base this conclusion upon my personal experience with Treasury officials during the course of our inquiry into the IBM/Lenovo acquisition.
   c. Based on the above, I have to ask myself, if the Treasury Department is still the appropriate place to handle CFIUS reviews. It seems to me that the Treasury Department has yet to see a foreign acquisition that it didn't like. I think it's time that the CFIUS process was administered by the Commerce Department, which already looks at industrial security issues.

Thank you for the opportunity to testify here today on these important issues and I look forward to answering any questions you may have.

Panel I: Discussion, Questions and Answers

Cochair REINSCH. Thank you very much, Mr. Manzullo. The Haier-Maytag example is probably, just thinking about it, a better one than Unocal. I'm not sure that people are going to get excited about countervailing duties cases against subsidized oil imports.

But, in any event, I've got a question or two, but I'll defer to Chairman D'Amato.

Chairman D'AMATO. Thank you very much, Commissioner Reinsch. Thank you again for your testimony, Congressman. We find it very important. On your comments on CFIUS, this Commission has basically taken the same position that you've just articulated, which is to broaden the definition of national security to include economic security and to get into transparency and required frequent oversight by the Congress of what kind of transactions are being reviewed and what judgments are being made in Treasury in letting these transactions through. It seems to us that that's something that is going to have to be done soon.

I have a question on the transfer of technology. I have a paper here that I'd like to get permission from the Commission to put in the record. It's on the Boeing Corporation. This is a recent paper called "Boeing's Diffusion of Commercial Aircraft and Design and Manufacturing Technology to Japan: Surrendering U.S. Aircraft Industry for Foreign Financial Support."

This is an astonishing paper about the transfer of technology by Boeing to Japan. We're not talking about China here. We're talking about Japan, but this technology will eventually go to China as well. We find that in 1960s, the 727 that was produced by Boeing, virtually all pieces of it were done in the United States—the wing, the center wing box, the front fuselage, the aft fuselage, the empennage, and the nose.

Then the 767 and 777s. They continued to make the wing and the nose, but transferred everything else to Japan, and now the newest aircraft that they are going to produce, the 787, virtually everything is going to be transferred to Japan, including the wing assembly and the technology to make the wings—something that Airbus won't do.

The only thing the United States will exclusively make on the 787 is the nose. So in this paper, I'd like to read a couple of statements to get your opinion on this. They say in outsourcing the 787 wings, Boeing is crossing an "economic Rubicon. No Boeing plane has ever flown on foreign wings." And they question Boeing's judgment on transferring closely guarded wing-making technology to the Japanese.

"This reinforces already existing fears that Boeing will not invest in its future with major upgrades in terms of capital equipment or infrastructure. In fact, we find that Boeing's level of R&D is now about three percent as opposed to 9.5 percent for Airbus, and that Boeing is allocating only about one percent of its revenues to capital investment compared to Airbus' 9.1 percent."

So what we have here is the transfer of one of the great jewels of American technology by a company that's in charge of that technology to a foreign country. The paper concludes by saying: "For the first time in U.S. commercial aviation history, a new aircraft launch has been structured in a fashion that gives foreign partners the control over design, manufacturing, sub-tier supplier selection, and ultimately the financial muscle to destroy what little remains of the U.S. commercial aircraft industry."

There are two parts to this question, Congressman. The first is a lot of the transfers that are occurring by Boeing to Japan are as a result of government-subsidized R&D and composite materials. This is R&D subsidized by the U.S. Government and composite materials.

The question is do we want to try and establish a national policy dealing with a major industry that appears to be being extinguished in a way that tries to salvage that industry? What do we do when we see an industry going out the door like that? That's my question.

Congressman MANZULLO. Well, first of all, I challenge the author of that work. Boeing has a huge presence in my district. Hamilton Sunstrand, which is a United Technologies Company, has been given 11 contracts to make virtually all the electrical and mechan-

ical systems on the Boeing Aircraft. And I've met with the folks at Hamilton Sunstrand. I'm working with them to get the small guys, the individual suppliers, AS–9100 certified, which means that they have international credentials for selling in the aerospace industry.

I don't know where the statement comes from that only the nose of the 787 is going to be made in America, but that's incorrect. The 787 has always been an international aircraft. It's always been touted that way. In fact, the composite materials and the machine, the seven-axis machine that wraps fuselages and wings with the composite, there are only two manufacturers left in the U.S. That's Cincinnati, which used to be Cincinnati Milacron, and Ingersoll Milling Machine and Tool in Rockford, Illinois.

In fact, there was a contract that the Pentagon gave to a Spanish firm over the Rockford firm on milling machines on the F–35 that led to the bankruptcy of Rockford's Ingersoll. So no one was monitoring the impact of that particular contract.

When you're dealing with composites, that's obviously very sophisticated. But I don't know if the Japanese don't know as much about that as we do. And I would really challenge that study.

Chairman D'AMATO. Thank you.

Cochair REINSCH. Thank you. Let me say we need to be cognizant of time here, both Mr. Manzullo's time, because I know he's busy, and Mr. Lichtenbaum's time. Peter has to leave at 11, although he's going to rejoin us for lunch. So I want to make sure we have enough time to have his statement and ask him questions, so maybe we can have Mr. Wessel and Mr. Mulloy ask a question and then move on.

Cochair WESSEL. Thank you, Mr. Chairman, for being here, and we've had a good working relationship with your staff and your office over some period of time. We certainly appreciate it.

I'd like to ask a quick question about the definitional issue you raised about national security because it was my understanding that the original statute contemplated economic security being part of the national security definition.

Congressman MANZULLO. You can't separate the two.

Cochair WESSEL. Clearly, you cannot separate the two. They're inextricably intertwined. I'd also argue that we have to look at it more broadly in terms of homeland security as well. There was a story some months ago that the California power grid was, they were outsourcing the software for that, and clearly if we were to bring the California power grid down through trapped doors, backdoors, whatever it is, through hackers, that could have an enormous impact.

What's your view on how broad should the definition be and how should we implement that?

Congressman MANZULLO. Well, it's obviously on an ad hoc basis. You have to look at every single one. Let me give you an example. With the printed circuit board industry, only 20 percent of the copper substrate is made in the United States. The rest is imported. That's done violence to the photomask industry that's used in the manufacture of the printed circuit board industry, which is under tremendous siege.

We found out that the Department of the Navy, N–A–V–Y, had decided to buy from the Chinese the printed circuit board that's

used on a buoy, an intelligence buoy, and so what did we do? We raised hell. The only thing you can do in this town to get somebody's attention, you have to embarrass them or you get to raise hell because nobody buys the policy argument.

Then the Navy hurried up and said, well, maybe we'll have to return that to the United States. That's the thinking, Mike. They just, everything is in the name of "best value." In fact, I talked to the general who came up with that term when I spoke at Heritage about two months ago. He was there. He said, Congressman, we never intended to get rid of, or to compromise our national security in the name of "best value." And that's exactly what is happening.

I would simply suggest that whenever a contract goes to a manufacturer overseas, that the Pentagon simply look upon the impact that it has on domestic manufacturing.

Cochair WESSEL. Thank you.

Cochair REINSCH. Which is something they're supposed to do anyway, I think.

Congressman MANZULLO. But they don't. No, they don't. We had the admiral who was the contracting officer on the F–35, and when the contract for the milling machine went, when Northrop Grumman bought it from the Spaniards as opposed to Ingersoll Milling, I asked the Admiral, "Didn't you take a look at the impact?" He said, "My only job is to monitor best value."

Cochair REINSCH. Mr. Mulloy, you have a question?

Commissioner MULLOY. Congressman, I want to salute you and your staff for all that you have done bringing these important issues to the attention of policymakers and the American people.

In 1988, when CFIUS was written into law, I was the General Counsel of the Senate Banking Committee and the Committee put that provision in as part of the Defense Production Act. In 1992, when we were renewing the Defense Production Act, we put a requirement into the law requiring the people who administer CFIUS, which was in the Treasury, to do a report every four years to the Congress on whether any country has a coordinated strategy to buy key U.S. technologies.

They did such a report once in 1993 and they have not done a report since then. I think this is an enormously important issue for the Congress, and I salute you and your testimony because it will be helpful to us in writing to the committees of jurisdiction. I think this is an issue that the Congress really needs to pay a lot more attention to.

Congressman MANZULLO. Small Business Committee doesn't have any jurisdiction. We would be glad to work with you on a letter to them.

Commissioner MULLOY. Yes, and we'll use some of the points in your testimony in crafting our letter, but I want to thank you and all you're doing in this area. I think it's the issue of the epoch for the United States.

Congressman MANZULLO. Thank you for all of your work. I appreciate it very much.

PANEL II: ADMINISTRATION VIEWS

Cochair REINSCH. Thank you very much, Congressman. You've been generous with your time. Mr. Lichtenbaum, come on up. I

failed to mention in the beginning, for all witnesses, including the preceding one and the current one, your full statement will be inserted into the record.

So if you want to deliver a more abbreviated version, feel free.

STATEMENT OF PETER LICHTENBAUM
ACTING UNDER SECRETARY FOR INDUSTRY AND SECURITY
U.S. DEPARTMENT OF COMMERCE, WASHINGTON, D.C.

Mr. LICHTENBAUM. Thank you. Mr. Chairman, Mr. Vice Chairman, Members of the Commission, thank you for inviting me to speak with you today about economic and security issues relating to U.S. trade with China. I appreciate the willingness to enter the full statement in the record, and therefore I will seek to abbreviate my remarks to the extent possible.

Today, I'd like to address three aspects of the Bureau of Industry and Security's work that I think are of particular interest to this Commission: U.S. dual-use export control policy with respect to China; U.S. export control policies relating specifically to the aerospace and semiconductor sectors; and the Commerce Department's role in analyzing industry sectors identified by the Defense Department in order to assess the capability of the U.S. defense industrial base to support U.S. national defense.

On the first issue, China poses particular challenges for U.S. dual-use export control policy because there are clearly immense potential benefits from expanding trade, but there are also serious concerns.

From the standpoint of market opportunity, China is a market with vast potential for expanding trade as it increasingly becomes more open to international investment and foreign presence. In terms of total trade, China became our third-largest trading partner in 2004, and in 2004, U.S. exports to China went up over 22 percent.

That increase in U.S. exports not surprisingly has included some dual-use goods such as semiconductor manufacturing equipment, chemicals, chemical manufacturing equipment and high-performance computers.

From a security standpoint, the U.S. Government remains concerned about China's modernization of its conventional military forces and the risk of diversion of sensitive dual-use items to Chinese military programs.

For example, building state-of-the-art semiconductor plants could increase China's ability to apply this technology and equipment in military programs. Advanced telecommunications equipment if illegally diverted to military end-users could provide the Chinese missile nuclear weapons and other military programs with the means to enhance performance in military radar applications.

China also has had limited success in the areas of building and enforcing their export control system and effectively meeting U.S. nonproliferation objectives, and as a result, the Administration has acted to impose sanctions on a number of Chinese entities that have exported sensitive items to countries of concern.

In response to these challenges, the Administration has promoted both our security and our economic interests in controlled trade with China. We are seeking to ensure that U.S. exports are not diverted to end-uses within China that we do not support and are not

reexported to other foreign government or terrorist weapons programs that are adverse to our interests.

The Commerce Department and other agencies carefully evaluate proposed exports of dual-use items to China on a case-by-case basis, taking into account the type of item to be exported and the proposed end-user and end-use. We do not issue licenses if the item or technology will make a direct and significant contribution to China's electronic and anti-submarine warfare, intelligence gathering, power projection or air superiority.

We also deny all items controlled for missile technology reasons that enhance China's missile or WMD delivery capabilities.

Moreover, we do not approve any licenses for military end-users or end-uses within China, which is consistent with the long-standing U.S. arms embargo, which the Administration and this Congress strongly support.

In the coming months, we will propose a new "catch-all" regulation that will require a license for otherwise uncontrolled exports that could materially assist the Chinese military and we will review any application that supports the advancement of Chinese military capabilities under a general policy of denial.

At the same time, the great majority of U.S. exports to China do not require a license and the great majority of licenses are approved. Expanding civil exports to China benefits U.S. firms and workers and fosters peaceful ties between our countries.

The United States has eased export restrictions affecting certain high technology non-strategic trade with China over the past few years and, for example, there have been significant liberalizations for computer hardware, general purpose microprocessors and certain semiconductor manufacturing equipment due to outdated technology control levels and the increasing foreign availability of these items.

We will continue to support legitimate exports that contribute to U.S. economic growth and facilitate China's peaceful economic development. And in this regard, the Chinese government has suggested that U.S. export controls are an important cause of U.S. trade deficit with China. That is not the case.

Export controls are not impeding overall U.S.-China bilateral trade. The total value of denied license applications for China last year was only about $10 million. Even the exports which we approved constituted less than two percent of overall U.S. exports to China and less than one percent of the value of our trade deficit with China, so it is orders of magnitude of difference between the items that we control versus the trade deficit.

Others have suggested that the United States could use export controls to assist certain U.S. industries by preventing the export of industrial equipment that is sought by Chinese high-tech manufacturing. However, it's important to note that U.S. export controls have never been intended as instruments of trade policy. Rather they were designed and served to protect U.S. national security and advance U.S. foreign policy interests.

And in any case, the bulk of such equipment could be provided by other countries. Accordingly, we should be cautious regarding such an expansion of export controls and only consider such an ap-

proach when a U.S. industry is both critical to national security and is threatened specifically by Chinese competition.

Let me now turn to two sectors I mentioned earlier, the aerospace and semiconductor sectors, in order to illustrate some of these complexities and challenges.

In the aerospace sector, China has been a large customer for U.S. origin civil aerospace systems. U.S. civil aircraft and engines are high-value exports with the added benefit of potential future exports for spare parts and service to support those systems.

Since many aerospace systems are controlled only for anti-terrorism reasons, they can be exported to commercial end-users and end-uses in China without the requirement for an export license, such as Boeing aircraft, for example.

However, other more sensitive aerospace items are controlled for national security reasons and are subject to a much higher level of review. Many of these are approved unless there is a risk of diversion to military end uses or third countries. And we have seen recently increased licensed activity in this area as Chinese aircraft manufacturing firms are becoming a more important supplier to the U.S. and European aerospace industries.

For example, Chengdu Aircraft Corporation has supplied Western aircraft manufacturers with major sections of several commercial aircraft. Looking ahead, China offers the potential to produce certain composite based parts, components and sections such as rudders for commercial aircraft.

In general, export licenses for commercial trade to China are reviewed under a policy of approval as long as they don't relate to the areas I mentioned earlier. However, composite materials have significant military end-uses and therefore those license applications would be denied if there is sufficient information showing they might be diverted to military end-users or third countries.

In the semiconductor area, China's emergence as a major player has similarly raised security and trade issues that reflect the export control policy challenges. Semiconductors, as you know, are standard building blocks for the global information infrastructure and for the U.S. military leadership, as the Defense Science Board recently emphasized in a report earlier this year.

China's semiconductor industry is growing rapidly. While China is a large consumer of chips, China's production capacity is currently limited in terms of their global market share. However, their spending on semiconductor manufacturing equipment is expected to grow significantly. Last year, semiconductor manufacturing equipment sales in China were $2.73 billion. The United States has about 50 percent of that growing market.

Those sales represent an opportunity for the U.S. semiconductor manufacturing equipment industry both immediately and in terms of generating revenue to support their R&D here in the United States and maintain their technology leadership, which is critical for their commercial success as well as for our national security needs.

From a national security standpoint, the equipment used to manufacture sophisticated semiconductors is tightly controlled for national security reasons by the United States and by other members of the multilateral Wassenaar Arrangement. While Wassenaar

members control the same equipment and technology that we do, non-U.S. suppliers often have significantly lower processing times for equipment and technology exports to China.

We are continuing to work with our regime partners to coordinate our export licensing practices and policies.

Under U.S. export control policy, license applications are reviewed on a case-by-case basis by the Commerce Department and our interagency partners including the Defense Department and the State Department.

We have a thorough process to vet end- users, but we do not have technology limits or "red lines" set forth in our regulations. Rather we approach licensing on a case-by-case basis based on what is being exported and to whom it is being exported. We believe that policy has yielded positive results for our national security interest as well as for U.S. exporters. We licensed over $240 million in such equipment last year, which was the largest single item in dollar value that we approved to China last year.

Finally, I want to take a couple minutes on the defense industrial base and our role monitoring that sector.

We conduct industry analyses at the request of the Department of Defense in most cases to assess the capability of specific components of U.S. industries to support national defense, and we survey industry in order to obtain essential employment, financial, production, R&D and other data, in order to provide findings and recommendations for government policymakers. The goal is to allow the government to monitor trends, benchmark industry performance and raise awareness of any diminishing manufacturing capabilities.

Since 2001, we've done 18 studies on a variety of sectors such as parachutes, munition power sources, batteries, and others. These studies, of course, are only part of the industries of interest to the Department of Defense, but they are the ones that Defense has asked us to study. And as we've done those studies, we've seen some firms reporting that they were unable to adequately maintain R&D levels, invest in production and process improvements or retain qualified engineers or scientists, and as a result, some companies that were committed to supplying the Defense Department have migrated to commercial sectors or downsized their operations. I'd be happy to discuss specific studies if of interest to the Commission.

In conclusion, I'd like to say I think it serves our common security, foreign policy and economic interests for the United States and China to continue to expand their economic relationship. At the same time, we have significant differences with China on security and foreign policy issues that dictate a cautious way forward in our overall political, economic and strategic relationship.

Once again, thank you for inviting me and I look forward to answering any questions you have related to my testimony.

[The statement follows:]

Prepared Statement of Peter Lichtenbaum
Acting Under Secretary for Industry and Security
U.S. Department of Commerce, Washington, D.C.

Mr. Chairman, Mr. Vice Chairman, Members of the Commission, thank you for inviting me to speak with you today about economic and security issues related to

U.S. trade with China. As the acting Under Secretary for Industry and Security at the U.S. Department of Commerce, I am responsible for overseeing the Bureau of Industry and Security's mission to advance U.S. national security, foreign policy, and economic interests by regulating the export of sensitive U.S. dual-use goods and technologies; enforcing export control, antiboycott, and public safety laws; and monitoring the ability of the U.S. defense industrial base to satisfy U.S. national and homeland security needs. Today, I would like to address three aspects of our work that I understand are of particular interest to this Commission:

- U.S. dual-use export control policy with respect to China.
- U.S. export control policies relating to the aerospace and semiconductor sectors.
- BIS's role in analyzing specific industry sectors identified by the Department of Defense, to assess capabilities of the U.S. industrial base to support the national defense.

As background, the Bureau of Industry and Security is responsible for implementing U.S. dual-use export controls. Dual-use commodities are commercial items that, while not designed for use as weapons, delivery systems, or for terrorist purposes, have the potential for these types of misuses. Sensitive dual-use items are identified on the Commerce Control List (CCL), which tracks, but also goes beyond, U.S. commitments under multilateral export control regimes. BIS works with other U.S. Government agencies, including the Departments of State, Defense, Energy, Homeland Security, and Justice, to protect the national security of the United States. BIS's principal objective is to ensure that direct exports from the United States and re-exports of U.S.-origin items from third countries are consistent with national security and foreign policy interests, without imposing unnecessary regulatory burdens on U.S. exporters or impeding the flow of legitimate trade. The ultimate goal is to prevent U.S.-origin items from falling into the hands of those nations, terrorists, and individuals who would use the goods and technologies against us and our allies. In short, the Administration seeks to structure our export control policies to address both the threats and opportunities that the United States faces in today's geopolitical landscape.

U.S. Dual-Use Export Control Policies Relating to China

China poses particular challenges for U.S. dual-use export control policy, because there are immense potential benefits from expanding trade but there are also serious security concerns.

From the standpoint of market opportunity, China is a market with vast potential for expanding trade as it increasingly becomes more open to international investment and foreign presence. In terms of total trade, China became the United States' third-largest trading partner in 2004 with $231.4 billion in imports and exports, behind only Canada and Mexico. U.S. exports to China have continued to rise for the past 20 years, and in 2004, U.S. exports to China went up over 22 percent. The increase in U.S. exports, not surprisingly, has included some dual-use goods, such as semiconductor manufacturing equipment, chemicals, chemical manufacturing equipment, and high performance computers.

From a security standpoint, the U.S. Government remains concerned about China's modernization of its conventional military forces and the risk of diversion of sensitive dual-use items and technology to Chinese military programs. For example, building state-of-the-art semiconductor plants could increase China's ability to apply this technology and equipment in military programs. Advanced telecommunications equipment—if illegally diverted to military end-users—could provide the Chinese missile, nuclear weapons and other military programs with the means to enhance performance capabilities in military radar applications. China has also had limited success in the areas of building and enforcing their export control system and effectively meeting U.S. nonproliferation objectives. The U.S. Government has imposed sanctions on a number of Chinese entities that have exported sensitive items to countries of concern.

Accordingly, the Administration has promoted both our security and our economic interests in controlled trade with China. We seek to implement a policy that ensures that U.S. exports are not diverted to end-uses within China that we do not support, and are not re-exported to other foreign government or terrorist weapons programs that are adverse to our interests. BIS and its interagency export control partners carefully evaluate proposed exports of dual-use items to China on a case-by-case basis, taking into account the type of item to be exported, and the proposed end-user and end-use. BIS does not issue licenses for sales of dual-use items and technology to China if the item or technology will make a direct and significant contribution to the PRC's electronic and anti-submarine warfare, intelligence gathering, power projection, or air superiority. We also deny all items controlled for missile

technology reasons that enhance China's Missile Technology Control Regime (MTCR) Category I missile or weapons of mass destruction (WMD) delivery capabilities.

Moreover, this Administration does not approve licenses for military end-users or end-uses within China, consistent with the long-standing U.S. arms embargo. In the coming months, the Department of Commerce will propose a new "catch-all" regulation that will require a license for otherwise uncontrolled exports that could materially assist the Chinese military, and we will review any application that supports the advancement of Chinese military capabilities under a general policy of denial.

At the same time, the great majority of U.S. exports to China does not require a license, and the great majority of licenses are approved. Expanding civil exports to China benefits U.S. firms and workers, and fosters peaceful ties between our countries. The United States has eased export restrictions affecting certain high technology non-strategic trade with China over the past few years. For example, there have been significant liberalizations in controls for computer hardware, general purpose microprocessors and certain semiconductor manufacturing equipment—due to outdated technology control levels and the increasing availability of these items in the global market.

We will continue to support legitimate exports that contribute to U.S. economic growth and facilitate China's peaceful economic development. In this regard, the Chinese government has suggested that U.S. export controls are an important cause of the U.S. trade deficit with China. This is not the case. Export controls are not impeding overall U.S.-China bilateral trade. The total value of denied license applications for China in 2004 was only $10.8 million. Even Commerce approved exports to China in 2004 constituted less than 2 percent of overall U.S. exports to China ($547 million approved out of total U.S. exports to China of $34.7 billion) and less than 1 percent of the value of our trade deficit with China ($162 billion).

Others have suggested that the United States could use export controls to assist U.S. industries, by preventing the export of industrial equipment that is needed by Chinese high-tech manufacturing. However, U.S. export controls have never been intended as instruments of trade policy. Rather, they serve to protect U.S. national security. And in any case, the bulk of such equipment could be provided by other countries eager to make similar sales. Accordingly, we should be cautious regarding such an expansion of U.S. export controls, and only consider such an approach when a U.S. industry is both critical to national defense and is threatened specifically by Chinese competition.

Let me now turn to two sectors to illustrate the complex process of managing our security and economic interests with respect to export control policy and China.

Aerospace Sector

China has been a large customer for U.S. origin civil aerospace systems. U.S. civil aircraft and engines are high-value exports with the added benefit of potential future exports for spare parts to support those systems. U.S. firms are providing the flight control systems, avionics and engines to support the Chinese Regional Jet Airliner (ARJ21) program. Since many aerospace systems are controlled only for anti-terrorism (AT) reasons, they can be exported to commercial end-users/end-uses in China without the requirement for an export license.

However, other more sensitive aerospace items are controlled for national security reasons and are subject to a much higher level of review. Many of these items are approved unless there is a risk of diversion to military end-uses or third countries. We have seen increasing licensing activity in this area as Chinese aircraft manufacturing firms are becoming a more important supplier to the U.S. and European aerospace industries. For example, Chengdu Aircraft Corporation has supplied Western aircraft manufacturers with major sections of several commercial aircraft. Looking ahead, China offers the potential to produce certain composite based parts, components, and sections (e.g., rudders) for commercial aircraft. Generally, export licenses for commercial trade in composite materials are reviewed under a policy of approval. However, composite materials also have significant military end-uses. Consequently, these license applications will be denied if there is sufficient information to indicate the items could be diverted to military end-users or third countries.

Semiconductor Sector

The emergence of China as a major player in the semiconductor market has similarly raised security and trade issues that reflect the export control challenges with respect to China. Semiconductors are standard building blocks for the global information infrastructure including computers, communications and consumer electronics. The semiconductor industry also provides much of the technology that underlies modern U.S. military leadership. China's semiconductor industry is grow-

ing rapidly. While China is a large consumer of chips, China's production capacity is limited in terms of global market share. However, China's capital spending on semiconductor manufacturing equipment is expected to grow significantly over the next few years. Last year, new semiconductor manufacturing equipment sales in China were $2.73 billion. The United States currently supplies about 50 percent of this growing market. This presents an opportunity for the U.S. semiconductor manufacturing equipment industry in both sales and as a means to finance future R&D in the United States and maintain technology leadership.

While the U.S. no longer controls the export of general purpose chips or microprocessors to civil end-users in China, the equipment used to manufacture sophisticated semiconductors is tightly controlled for national security reasons by the United States and other members of the Wassenaar Arrangement. While all Wassenaar Arrangement members control the same equipment and technology, non-U.S. suppliers often have significantly lower license processing times for equipment and technology exports to China. The U.S. Government is continuing to work with our regime partners to update control lists and to coordinate export licensing practices and policies.

Under U.S. export control policy, license applications for semiconductor manufacturing equipment and technology are reviewed on a case-by-case basis by the Departments of Commerce, Defense, State, Energy and the intelligence community. The review process is thorough as the interagency vets the end-user to mitigate concerns that the technology will be diverted. There is a policy of denial for exports for military end-users/end-uses in China.

There are no predetermined technology limits or "red lines" set forth in the Export Administration Regulations, but we carefully evaluate the quantity and quality of the equipment and technical know-how proposed for export to assure that it is necessary for, and not in excess of, the civil end-uses stated in the license application. Since 2002, this policy has yielded positive results for U.S. exporters while protecting U.S. national security interests. In 2004, the U.S. approved semiconductor manufacturing equipment (SME) exports to Chinese foundries well in excess of $240 million, making SME the largest single licensed item by dollar value.

Monitoring the Defense Industrial Base

BIS conducts industry analyses, usually at the request of the Department of Defense, to assess capabilities of specific components in the U.S. industrial base to support the national defense. By using industry-specific surveys to provide essential employment, financial, production, R&D, and other data, these reports provide findings and recommendations for government policymakers and industry leaders. The goal is to enable the private sector and government agencies to monitor trends, benchmark industry performance, and raise awareness of any diminishing manufacturing capabilities.

Since 2001, the Office of Strategic Industries and Economic Security within BIS has conducted 18 studies on a variety of industrial sectors, including munitions power sources, biotechnology, and parachutes. These studies, of course, represent only part of the industries of interest to the Department of Defense. As we conducted these studies, some firms reported that they were unable to adequately maintain sufficient R&D expenditure levels, invest in production and process improvements, or retain qualified engineers and scientists in the face of shrinking markets or as a result of a more competitive marketplace. As a result, some companies that were committed to supplying the Department of Defense have migrated to commercial sectors or have downsized their operations.

As an example of our work, one of the studies that BIS has completed involved a request from the U.S. Army to assess the health of the U.S. parachute industry. This study was requested by the U.S. Army because there were problems with timely delivery of parachute orders from industry. The U.S. Army was concerned that it would not be able to procure parachute systems quickly to deliver sophisticated devices into the modern battlefield. During the past decade, there was significant uncertainty in the parachute industry due to fluctuating demand. As a result the industry was faced with inventory control and procurement issues, diminishing R&D, and new competition from non-traditional sources. BIS recommended that the Army improve demand forecasting and increase funding for the development of new manufacturing technology.

In conclusion, it serves our common security, foreign policy, and economic interests for the United States and China to expand our economic relationship. At the same time, we continue to have significant differences with China on security and foreign policy issues that dictate a cautious way forward in our overall political, economic, and strategic relationship. While this may slow the entry of certain sensitive

U.S. industry sectors into the Chinese marketplace, we must protect U.S. national security and foreign policy interests.

Once again, I thank the U.S.-China Commission for inviting me to speak with you today about these issues. I would be pleased to answer any questions you may have related to my testimony.

Thank you.

Panel II: Discussion, Questions and Answers

Cochair REINSCH. Thank you very much. Mr. Wortzel.

Cochair WORTZEL. Thank you very much for your taking the time to be here, and it was great testimony. I think you've covered a wide area and we appreciate it.

I want to draw you out a little on what measures as a Department that you might be taking with foreign countries or allied countries to discuss military-related export restrictions to China. I know the State Department has been involved in a very heavy effort with the European Union on that, but I'm not certain what Commerce may be doing to support that.

I don't find Wassenaar particularly useful or effective. When the Commission was in Brussels last year, members of the European Commission and European Parliament expressed their willingness to begin to consider again export control restrictions on particularly unique military-related technologies that wouldn't rise to the level of what CoCom was, but certainly would help address American security concerns. I wonder if you could describe the efforts of your bureau and the Commerce Department in parallel with those of the State Department and Department of Defense?

Mr. LICHTENBAUM. I'd be happy to. First, with respect to the question of arms sales to China, the United States has an arms embargo in place and the European Union currently has an arms embargo in place. The United States has been very united, both in the Administration and in the Congress in urging the European Union to maintain that arms embargo.

We believe we have had some success in at least delaying the lifting of the arms embargo, and we appreciate the support we've gotten from the Congress on that issue. In connection with that effort, the State Department has initiated a strategic dialogue with the European Union—Mr. Javier Solana is leading that for the Europeans and Under Secretary Nick Burns from the U.S. side—in order to promote convergence and understanding of what the U.S. concern is. We hope to persuade the Europeans to maintain that arms embargo which remains so important from a human rights and a national security perspective.

To the question of dual-use items that could have military applications, it is certainly true that Wassenaar is no CoCom, and that reflects the changed global reality in which there was a shared consensus as to the Soviet Union, the threat that we were responding to under CoCom. There was not at the time Wassenaar was established, as Mr. Reinsch will recall, the same consensus with respect to other targets of U.S. export controls such as China, and that is the world in which we live today.

I think that it is worth exploring whether it is possible to take the recommendation of the Defense Science Board from earlier this year to establish supplementary agreements with our Wassenaar partners in critical areas with respect to exports to certain coun-

tries of concern, and that is something that I think warrants very careful attention by the Administration.

Cochair REINSCH. Thank you. We have a lot of people who want to ask questions. Let me just say that we'll keep going as long as Peter can stay, and if we don't get to you, fellow Commissioners, he'll be back at lunch, and you can hit him then, and that's the best we can do because I don't want to mess up your next appointment.

Mr. Wessel.

Cochair WESSEL. Thank you once again for being here. We are very appreciative that your schedule could allow you to be here today. I want to ask two questions that your testimony raises. You talked about this "catch-all" provision. And I'm somewhat intrigued by that because I think it shows flexibility in terms of desiring to protect our security interests, but I'm somewhat questioning how, in fact, that would work in reality.

Would that require that a much broader range of exports be subject to review in terms of the transactions? How does that work? There's now a list and people essentially understand what is covered and what they need to come in for a license. You say these uncontrolled exports, which means are you going to have a new list? Is it like, "I'll know it when I see it" standard? How do you think this is going to work?

Mr. LICHTENBAUM. Well, let me say that we have precedent for this in our regulations. As you say, we do have a Commerce Control List which identifies the sensitive items, but ever since the first Bush administration in 1991, we have had an Enhanced Proliferation Control Initiative, or EPCI, which does control even non-sensitive items if they're destined for certain end-uses, such as nuclear weapons programs, chemical and biological programs, missile programs, in certain countries, in order to ensure that U.S. firms do not support proliferation concerns.

So I think U.S. companies are accustomed to screening transactions against the end-user in order to be sure that even if they are selling a non-controlled item, it is not going to certain particularly sensitive end-users. China is certainly, as I said in my testimony, a very significant market for U.S. industry, and we do have to be careful in imposing additional controls with respect to that market and not inadvertently catching items that under no scenario could make a material contribution to the Chinese military—pencils, chairs, staples.

As you say, there is a wide list. The vast majority of items in the U.S. economy are not considered as sensitive items. So our task, I think, is to identify those items that could make a material contribution to the Chinese military and that is something that we at the Commerce Department are working with other agencies to do.

Cochair WESSEL. So there will be a list of potential end-users where transactions will raise more sensitive concerns. Is that how this will work?

Mr. LICHTENBAUM. I don't know that we would list end-users, but as we've already done in our regulations, in the particular case of general purpose microprocessors where we have decontrolled general purpose microprocessors to China, except when they're destined to a military end-use, we might model on that provision and

allow the U.S. companies the responsibility to determine when something is being used for a military purpose or not.

Because the problem with a positive list frankly is that the Chinese could easily set up a new entity, which is not on our list and then our control loses all meaning.

Cochair WESSEL. Well, it seems as hard to impose upon a sales agent the determination of whether it's a military end-use as well. This is all a difficult area to police and to ensure that our security interests are being protected. Hopefully, as you move forward on this, we'll have further discussions.

Let me understand one other area if I could. In terms of your industry analyses that BIS conducts, are you looking at the subsidies that another nation may be offering to its semiconductor foundries, et cetera, to be able to look back and determine what the competitive posture of our industry may be and what it faces over the next several years?

Mr. LICHTENBAUM. Well, that's not a specific focus of the reports, but it is not excluded from the reports either. So if we found that subsidies were a relevant factor in the condition of the U.S. industry, then we would certainly report on that. There is nothing off the table.

Cochair WESSEL. But are you looking for them so the Chinese subsidy as it relates to semiconductor foundries, R&D, as you look at this, are you looking for the subsidy or is it information that has to be presented, if you will? It's not in the normal course of your evaluation.

Mr. LICHTENBAUM. Well, I think that the questions that are asked in those surveys that we do would capture that type of information. We haven't done a study of the semiconductor industry. We haven't been requested to do one by the Defense Department. I'm not aware that subsidies have surfaced in the industries that we have looked at as a particular concern, but if they were to surface, in response to questions that we ask, which are broad enough to elicit that type of information, then we would report on that.

I think with respect to subsidies in the semiconductor area, right now the people who are most focused on that would be at USTR and in the International Trade Administration of the Commerce Department.

Cochair WESSEL. Thank you.

Cochair REINSCH. Thank you. Let me just follow up on thing for one minute if I may. It seems to me that the universe of material contribution to military end-use is a far larger universe than the material contribution to WMD, and that this implies potentially an enormous expansion of items that would be captured in this net.

For example, your testimony alluded to AT items and aerospace. Isn't there a real likelihood here that this regulation that you're contemplating is going to capture most or all aerospace items going to China?

Mr. LICHTENBAUM. I don't think so. I don't think that Boeing, for example, would knowingly sell aircraft to the Chinese military, and so——

Cochair REINSCH. Military end-use is not military end-user. Are you going to go by end-user or end-use?

Mr. LICHTENBAUM. The regulation would focus on military end-use. But, I don't think that Boeing would be selling aircraft knowing that the aircraft were for military end-use either. The idea that they would knowingly sell a 737 that they knew would be modified for a military purpose seems counterintuitive to me.

Cochair REINSCH. We had this debate 15 years ago—Mr. Freedenberg, who is in the audience, will remember—over trucks in exactly the same way and helicopters that could be used for military transport.

Mr. LICHTENBAUM. No, and clearly I do want to draw a line there that we are not talking about whether an item is capable of military end-use. Merely because a plane is clearly capable of military end-use doesn't in our view give the exporter knowledge that it will be used for military purpose. Therefore we'd be happy to make that clear to the exporting community.

Cochair REINSCH. So it's not a capability.

Mr. LICHTENBAUM. It's not a capability.

Cochair REINSCH. Well, that's encouraging. I apologize for stealing Ms. Dreyer's time. Go ahead.

Commissioner TEUFEL DREYER. Thank you again. This is very interesting testimony. I am taking note here when you say that the Bureau of Industry and Security and its interagency export control partners carefully evaluate proposed exports of dual-use items to China on a case-by-case basis. And that BIS would not issue licenses for sales of dual-use items and technology to China if the item or technology will make a direct and significant contribution to the PRC's electronic and anti-submarine warfare, et cetera.

This Commission held hearings in Akron this past fall, and there we heard testimony from a company run by a U.S. Navy veteran that manufactured equipment used in American submarines. He found that some of the masks being used in U.S. submarines were being imported from China. He at least felt strongly that this was a distinct chink in U.S. security and in submarine security.

Now, I realize that you're going to need the details before you can respond to this. If we supplied you with the details of that testimony, could you get an answer back to us on this: whether it slipped through some kind of crack, or whether there some improvement in the legislation that would be necessary?

Mr. LICHTENBAUM. Yes, Commissioner Dreyer. I'd be happy to look into that if you provide the information to us. On hearing it for the first time, it sounds to me like it is not a question of export controls, but of procurement, and whether there is any concern really from a Defense Department standpoint in having procured an item for the submarine that is of Chinese origin, but I'd be happy to look at the information and arrange a response either from us or from the Defense Department, if appropriate.

Commissioner TEUFEL DREYER. I would be very, very interested in that and thank you, because our witness was convinced that this is a breach of U.S. security. And, of course, it was simultaneously forcing him out of business.

Thank you.

Mr. LICHTENBAUM. Thank you.

Cochair REINSCH. Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you very much, Mr. Chairman. Thank you to our witness for appearing today and also thank you for your service to the country. I see that you were at a very big law firm before and I imagine you've taken quite a financial hit coming in working for the U.S. Government, but your expertise is really valued.

I have two questions. One is you make a point of noting the state of the overall U.S.-China trade relationship, which I think is only telling a piece of the story. You note that U.S. exports to China continued to rise over the past 20 years and, of course, U.S. imports from China have risen quite more significantly than the exports.

We had over $160 billion trade deficit with China, and I just wondered if you would please lay out for us a little bit more the state of what is the rise? You say U.S. exports went up over 22 percent in 2004. U.S. imports from China went up what percentage in 2004?

Mr. LICHTENBAUM. Well, I don't have that information. And I agree that it is important to have all the information in order to evaluate the trading relationship that we have with China. The trading relationship, of course, generally does not fall within my particular expertise but really within USTR in the first instance and the International Trade Administration of the Commerce Department. I'd be happy to supply the information for the record if that would be helpful.

Commissioner BARTHOLOMEW. Yes. I think that would be useful. I think it's about honesty in discussing the trade relationship that we talk about the trade flows that go each way.

I'm not an expert on export controls and defer to people on this Commission who have actually worked on these issues. Several weeks ago in the Washington Post there was a photograph of a North Korean soldier, and I happened to notice that that soldier had attached to his belt what looked like a walkie-talkie that said Motorola on it. Now, we have an embargo with North Korea, do we not?

Mr. LICHTENBAUM. Actually we do not have a broad trade embargo on North Korea of the type that we have historically had with the country. I believe in 2000, actually, the Clinton administration removed the broad trade embargo on trade with North Korea. From a standpoint of U.S. export controls, North Korea is one of the countries to which we have the most stringent controls, and basically any item on our list of sensitive items, including the anti-terrorism items, would require a license for export to North Korea because North Korea is designated as a state sponsor of terror.

But non-sensitive items could at this point be exported to North Korea without a license. I don't know whether the Motorola walkie-talkie is a controlled item or not. If it were a controlled item, it would have needed a license to be exported or reexported to North Korea.

Commissioner BARTHOLOMEW. My question in this case is do you have a procedure somewhere in Commerce or do you in your own agency have a procedure to look into a situation like this? It would be very interesting and useful to know where did the North Korean military get these Motorola communication devices and again some

of it is my ignorance about the export control system, but it would seem to me that providing a telecommunications device to a military of a country is not the same as providing a telecommunications device to the domestic market.

So I'm really trying to understand if, for example, is there someplace in the U.S. Government where somebody would investigate this to find out what happened? How do we get something like that going?

Mr. LICHTENBAUM. Well, you've come to the right place. We have an export enforcement part of the Bureau and we investigate cases of illegal exports or reexports. If it was a controlled item, then most likely it would have been an illegal export or reexport, perhaps by the North Koreans buying the Motorola phone in China or Hong Kong or someplace where the phone could go, and then reexporting it illegally to North Korea.

So if we had information about a particular case, then we can look into that. I do want to note that in connection with the "catch-all" rule that we were discussing a few moments ago, that rule is actually broader than China. It applies to all countries that are the subject of a comprehensive U.S. arms embargo as North Korea is.

So once we have that rule in place, if you know that an item is going for military end-use in an arms-embargoed country, the export would require a license from us.

Commissioner BARTHOLOMEW. That's progressive though. I presume from the point at which the rule goes into place, it will be from that point on?

Mr. LICHTENBAUM. Yes, that's correct.

Commissioner BARTHOLOMEW. What would one need to do if one wanted to know where the North Korean military got this telecommunications equipment now? What steps does one need to go through in order to get an investigation started?

Mr. LICHTENBAUM. That varies tremendously case-by-case. Often export enforcement investigations start with a tip from a participant in a transaction. We're not likely to have a tip in this scenario.

Commissioner BARTHOLOMEW. A photograph in the newspaper?

Mr. LICHTENBAUM. Well, yes, but then to go upstream and unwind the transaction may be difficult. One could approach Motorola, I suppose, and ask if they have any sales to the North Korean military, but I expect the answer would be no. It may be very difficult in that type of situation to determine exactly how the North Koreans got this Motorola phone. I just want to be honest with you about the difficulties in that.

Cochair REINSCH. Thank you.

Commissioner BARTHOLOMEW. I think, Mr. Chairman, we'll mark this as something that perhaps we need to look into a little more.

Cochair REINSCH. Mr. Becker.

Commissioner BECKER. Thank you, Mr. Chairman. Mr. Lichtenbaum, I would like to share a bit of a frustration that I've had for some time. In 1995, a company by the name of Magnequench that I think was in Peter Visclosky's district, congressman, but certainly in upper Indiana. The company was sold to the Chinese and at the time the Chinese that bought it had family ties that indicated military connotations. It went through a

CFIUS process, and it was judged to be okay to sell to them because, one, they were keeping the plant in the United States. They were not going to strip it and move it out so it would still be productive here in this country.

After that, there were several acquisitions made by Magnequench, and I think around 2000-2001, in there, the company decided they wanted to move everything to China, that it wasn't profitable in the United States, they said, and at that time, it didn't require a CFIUS process. I think it was an export deal because it was their company.

And this was reviewed. Governor Bayh and Congressman Visclosky raised objections to this and triggered several inquiries to this Administration, none of which were even responded to.

In the end, the plant was shut down, the people were terminated, and the process went to China. Now, in the purchase of Magnequench, the Chinese also obtained all the patent rights to the process. Now, this plant produced magnets that were used in Smart Bombs, and this was the argument that was raised by Visclosky and Bayh, that this was a national security item, and strong steps should be taken to protect this to keep it in the United States. That was rejected.

Upon subsequent investigation by myself and another Commissioner just to try to find out what the thinking was when they allowed the transfer to take place, it was determined that we had no proof that they were going to use this for military application, that the Chinese said they were going to use it for civilian applications.

The fact of the matter is we used it for military applications and should have been very concerned that the Chinese were going to use it for military applications also.

Anyway, the plant is gone and the process is gone, the patent is gone. Our second, third, fourth generation development in this process won't belong to us; it will belong to the Chinese because they have the patents on this. The reason I raise this now is I noticed in a paper just the other day that the second-largest company in the world that produces this type of magnets is in Canada, and Magnequench is now purchasing this plant.

I don't think the sale has gone through, but they've initiated the action to purchase the plant and a press release was issued, and it even said in there that this would be of monopolistic dimensions, that they would control the process throughout the world.

I said I wanted to share a frustration with you because this went through a government review, and it still left, and my question, if there is one on this, is there any way to reverse this? Is there any way that the government can take a look at this and say, hey, wait a minute, this was not the right information, and we made a bad decision, and we want it back and we want the patents back; we want the process back? Is that a possibility?

Mr. LICHTENBAUM. Well, Commissioner Becker, thank you for the question and for explaining the history and your frustration with the process. I believe the case occurred before I took office and, therefore, I'm not familiar with the specifics either of the original CFIUS determination or of any export licensing review that was done. So it's hard for me to address the quality of the decision-making in either the CFIUS or the export licensing process.

Certainly if people asked questions and didn't get answers, I believe that would have been unfortunate because I think Members of Congress are entitled to answers to their questions.

Commissioner BECKER. Would it help if we sent you the background information that we have on this? Would this be something that you would want to review?

Mr. LICHTENBAUM. Well, it would certainly be of interest and I would certainly review it if you send it to me. What actions we can take are very hard for me to opine on in the absence of having seen the record.

The one area that comes to mind is that if it was an actual approval of an export license, then there would likely be license conditions associated with the approval of the export license, and if those conditions were violated, that provides some basis for action.

But that's a statement I'm only making in principle, as I don't know the facts, and I would be happy to review them if you supply them.

Commissioner BECKER. All right. Thank you.

Cochair REINSCH. Thank you. Let's see if we can squeeze in Mr. Donnelly and then we'll have to let Peter go if that's all right? Or do you have to go sooner than that?

Mr. LICHTENBAUM. That's fine.

Commissioner DONNELLY. Mr. Chairman, I'll talk as rapidly as possible in order to maximize my time. I'm particularly interested and I appreciate the testimony because it does seem to me we came pretty close to getting to the subject of the hearing, which is the impact of U.S.-China trade on the defense industrial base. It seemed to me at the end of your testimony you were almost there when you started talking about actual effects on U.S. defense companies.

However, you didn't quite make the link to U.S.-China trade. I read your prepared testimony about the U.S. parachute industry and was interested to note that problems in the parachute industry were largely due, to use the euphemism, to uncertainty in the parachute industry due to fluctuating demand.

In other words, the Army wasn't buying enough parachutes or supporting parachute R&D, suggesting that many of the problems of the defense industry originate in the United States and are a result of perhaps overcapacity or underinvestment by the government in the defense industry.

So my question is do you have an example where it's clear that issues of U.S.-China trade have had an effect on the U.S. defense industrial base and the measure of merit being its ability to supply U.S. armed forces with the stuff that they need?

Mr. LICHTENBAUM. I don't have an example at my immediate recourse. I think China, as far as I know, was not a significant issue in the parachute study, but certainly as this hearing shows, and as I'm sure that there will be further discussion of in the afternoon, U.S. trade with China and Chinese investment decisions do have a significant impact on the defense industrial base.

But that is an issue that I don't think was addressed in the particular study you're referring to.

Commissioner DONNELLY. Well, I kind of set you up a bit, I confess, but I do hope that we get to the actual issue of the hearing in the full course of time.

Cochair REINSCH. Thank you. Mr. Lichtenbaum, we're, I think, at this point at your disposal. Do you need to leave or do you have more time?

Mr. LICHTENBAUM. I am going to have to leave although I will be happy to continue the discussion over lunch, and I very much appreciate the opportunity to appear and the excellent questions that I received from all Members of the Commission. Thank you.

Cochair REINSCH. Well, we appreciate your coming. You were very popular. We have actually four more Commissioners including myself who wanted to ask questions so we would be delighted to have you return for lunch and maybe we can continue the discussion there, and I appreciate those who didn't have an opportunity for forbearing. We will now take a brief recess while we wait for the next witness.

Chairman D'AMATO. Thank you.

Cochair REINSCH. Thank you.

[Recess.]

Chairman D'AMATO. The Commission will come to order. Let's resume our consideration of these events, and I would to pass the gavel on to Commissioner Wortzel who will be officiating at this point. Commissioner Wortzel.

OPENING STATEMENT OF COMMISSIONER LARRY M. WORTZEL HEARING COCHAIR

Cochair WORTZEL. Good morning. The capacity of American industry to innovate, surge production and meet the needs of American military has been a really critical factor in national security.

Today, many Americans are concerned that the shift of American production capabilities overseas will leave the United States unable to respond to future security challenges. If we fail to pay attention to our defense industrial base, should another major conflict require a surge in the production of new weapons or the support of our armed forces with intelligence and materiel, the United States may not be able to do so.

In some cases, critical industries are shifting to China, which, of course, is the principal focus on this Commission. In other cases, American leaders are concerned that excessive dependence on other countries for defense production could leave the United States unable to surge in capacity should an ally fall or should an ally refuse to cooperate with the United States because of disagreements over policy.

We seek to explore some of these issues today with this hearing. As we approach these matters, I want to suggest a few basic principles that I think will help our work.

First, innovation is really critical to industrial capacity and America's ability to respond to new situations. So it would be a mistake, in my view, to bind industry and entrepreneurial activity with excessive legislation and government regulation.

Excessive central planning and a national industrial policy could actually harm our national security. Also, if a technology, material

or industrial process is widely available in the global marketplace, it doesn't need to be protected as part of a defense industrial base.

National security should not be an excuse for protectionism. We should focus on critical technologies, industries and skills where the United States' lead is absolutely unique and these things have military application.

Our policies should encourage investment in research and development to support a robust defense industrial base. But the United States doesn't need the capacity to do everything. There should be cooperation and sharing with close allies. There are some allies that so closely share American values and interests that they can be relied on as good partners.

The United States and our allies have to protect critical unique defense-related technologies from potential adversaries. Our security policies should impose research, development and manufacturing costs on potential adversaries and competitors. We should not allow potential adversaries to steal technology or to insist that it be transferred to them as some incentive for investment in another area.

If a cooperating partner or ally transfers militarily critical technologies, weapons or industrial capacity to a potential adversary, that partner should be eliminated from future cooperation in that area in our defense industry, and this policy should apply not only to companies but also to nations.

America's closest allies should be considered to be reliable partners for all defense materials. If they prove to be pursuing policies that harm American interests, then we should address the matter and reevaluate our geostrategic partnerships.

I think there are only a few nations that might seriously challenge the United States from a security or an economic standpoint in the future. China is certainly one of them. I would say Iran bears watching. So do India and Russia. Now, in the late 1970s and 1980s, the United States enjoyed a good strategic partnership with China. The two nations cooperated closely in the security sphere to frustrate Soviet military expansion and to frustrate the expansion of the socialist Republic of Vietnam into Cambodia and potentially into Thailand.

But the use of the Chinese military to suppress democracy at home and the fall of the Soviet Union changed the basis for that cooperation. Over the past 15 years, the Chinese defense budget has grown at a double-digit rate annually. China has added military capacity that is specifically designed to be used against Taiwan and American military forces.

At the same time, China and the U.S. have parallel or complementary national interests in a number of areas, including trade, banking, combating illegal drugs, and maintaining security on the Korean peninsula.

Therefore, it's prudent to ensure that the capacity of the United States to respond to potential challenges is strong even while we cooperate in other areas with China. With that, I'd like to move to our next panel.

It's a great honor for me to introduce Dr. William Schneider. I don't think there is anyone more qualified to speak on the U.S. defense industrial base. Dr. Schneider is presently the Chairman of

the Defense Science Board. From 1982 to 1986 he served as Under Secretary of State for Security Assistance, Science and Technology.

He's also served as Chairman of the President's General Advisory Commission on Arms Control and Disarmament. He's a valued consultant to the Departments of State, Defense and Energy, and I look forward to his comments today.

Thank you, Dr. Schneider.

[The statement follows:]

Prepared Statement of Commissioner Larry M. Wortzel
Hearing Cochair

The capacity of American industry to innovate, surge production, and meet the needs of the American military has been a critical factor in national security. Indeed, in fighting and winning World War I and World War II, the strong American industrial base facilitated allied victories.

Today, many Americans are concerned that the shift of American production capabilities overseas will leave the United States unable to respond to future security challenges. If we fail to pay attention to our defense industrial base, should another major conflict require a surge in the production of new weapons or the support of our armed forces with intelligence and material, the United States may not be able to do so.

In some cases, critical industries are shifting to China, the principal focus of this Commission. In other cases, American leaders are concerned that excessive dependence on other countries, for defense production could leave the United States unable to surge in capacity should an ally fall, or refuse to cooperate with the U.S. because of serious disagreements over policy.

We seek to explore some of these issues today with this hearing. As we approach these matters, I want to suggest a few basic principles that I think will help our work. First, innovation is critical to industrial capacity and America's ability to respond to new situations. It would be a mistake to bind industry and entrepreneurial activity with excessive legislation and government regulation. Excessive central planning and a "national industrial policy" can harm our national security.

Also, if a technology, material or industrial process is widely available in the global marketplace, it does not need to be protected as part of a defense industrial base. National security should not be an excuse for protectionism. We should focus on critical technologies, industries and skills where the United States lead is absolutely unique and has a military application.

Policies should encourage investment in research and development to support a robust defense industrial base. But the United States does not need the capacity to do everything. There should be cooperation and sharing with close allies. There are some allies that so closely share American values and interests that they can be relied on as good partners.

The United States and its allies must protect critical, unique defense-related technologies from potential adversaries. Our security policies should impose research, development and manufacturing costs on potential adversaries and competitors. We should not allow potential adversaries to steal technology, or to insist it be transferred to them as some incentive for investment in another area. If a cooperating partner or ally transfers militarily critical technologies, weapons or industrial capacity to a potential adversary, that partner should be eliminated from future cooperation in that area. This policy should apply not only to companies but also to nations.

America's closest allies should be considered to be reliable partners for all defense materials. If they prove to be pursuing policies that harm American interests, then we should be prepared to address the matter and if necessary re-evaluate our geostrategic, military and economic partnerships.

There are few nations that might seriously challenge the United States from a security or economic standpoint in the future. China is certainly one of them. I would say Iran bears watching. So do India and Russia. In the late 1970s and 1980s the United States enjoyed a good strategic partnership with China. The two nations cooperated closely in the security sphere to frustrate Soviet military expansion and to frustrate the expansion of the Socialist Republic of Vietnam into Cambodia and potentially into Thailand. The use of the Chinese military to suppress democracy at home as well as the fall of the Soviet Union changed the basis for that cooperation.

Over the past 15 years the Chinese defense budget has grown at a double-digit rate annually. China has added military capacity that is specifically designed to be

used against Taiwan and American military forces. At the same time, China and the U.S. have parallel or complementary national interests in a number of areas, including trade, banking, combating illegal drugs, and in maintaining stability on the Korean peninsula. Therefore, it is prudent that we ensure that the capacity of the United States to respond to potential challenges is strong, even while we cooperate in other areas with China.

With that, I'd like to move on to our next panel. It is a great honor for me to introduce Dr. William Schneider. There is no one more qualified to speak on the U.S. Defense Industrial Base. Dr. Schneider is presently the Chairman of the Defense Science Board. From 1982 to 1986, he served as Under Secretary of State for Security Assistance, Science and Technology. He has also served as Chairman of the President's General Advisory Committee on Arms Control and Disarmament. He is a valued consultant to the Departments of State, Defense, and Energy and I look forward to his comments today.

PANEL III: THE DEFENSE INDUSTRIAL BASE AND THE 21ST CENTURY WARFIGHTER

STATEMENT OF WILLIAM SCHNEIDER
PRESIDENT, INTERNATIONAL PLANNING SERVICES, INC., WASHINGTON, D.C.

Dr. SCHNEIDER. Thank you, Mr. Chairman, and distinguished Members of the Commission. It's a great privilege to have an opportunity to appear before you to discuss a topic that's been a preoccupation of my own as far as study and work throughout my career in the government and I'm particularly comforted by the fact that this Commission is taking it up in the context of reviewing the economic and security aspects of our relationship with the PRC.

The industrial base is indeed an extremely important attribute of American power that needs to receive careful attention by those with public policy responsibilities. The President's efforts to transform the capabilities of the U.S. defense establishment to meet the security needs of the 20th century are implemented through that defense industrial base, and its ability to secure unchallenged technological superiority is a decisive part of the U.S. basic national security strategy.

So the stakes in maintaining the effectiveness of the U.S. industrial base which has been the margin of victory for our military forces for the entire period of the impact that the Industrial Revolution has had on warfare makes it imperative for us to try and understand how that matter applies today. And I think there's some very important characteristics about the industrial base and indeed how warfare is being conducted that bear on how we manage the industrial base.

Because in certain ways, the term "industrial base" doesn't quite capture what has happened to the way in which technology is acquired and applied to military forces. There's been a number of fundamental changes and just thinking about things a bit in a rather aggregated way, if you think about the period from the post-Civil War period through World War II, a large fraction of our defense technology was developed in secret through a series of government-owned facilities, typically government arsenals or naval shipyards, and the defense technology tended to have unique applications for military purposes and maintaining the secrecy of its development was often a decisive part of its effectiveness in its wartime application.

But certainly the signs were abundantly clear during World War II and certainly in the last half of the 20th century that the focus

of the development of advanced technology for military applications had moved decisively from government-owned facilities into the private sector. The aerospace and defense industry that was built up during the World War II period in particular became the focus of the innovation of advanced technologies that were applied for military purposes, important advances like, say, microprocessors. Since we've just had the death of the founder of the microprocessor this week, it's appropriate to remember that its initial applications were for military purposes even though it has profoundly changed the civil economy as that invention spun out from the defense sector into the civil sector.

What has started to happen during the latter part of the 20th century and is proceeding very aggressively now has been the shift in the focus of where technology is developed that is used for military applications. It's gone from the defense sector to the civil sector. Most of the decisive technologies that are applied for defense purposes are coming out of the civil sector.

They are systems engineered and integrated in a defense sector that has unique skills and is perhaps the most important part in the chain of evolution of technology that converts often mundane civil sector technologies into advanced military capabilities by the way in which they system engineer them.

But this calls attention to the fact that the defense sector is likely for the foreseeable future to be dependent in significant ways on the civil sector for innovation in selected areas of technology, and this is an important thing that we have to capture and undoubtedly is reflected in the concerns of this Commission where you have taken note of the fact that many of the technologies that have military applications are produced in the PRC and indeed in many other countries of the world.

In looking at the modernization themes that are characterizing the transformation of the U.S. defense establishment, the most succinct way of describing it is by pointing to two characteristics. One is the decisive importance of information as the discriminator in modern military performance. I can give you a metric that is correlated with the degree to which information is becoming a dominant characteristic of military performance.

If you take as a baseline the operation Desert Storm in 1991 and compare that to the next major engagement where U.S. forces were engaged in the air campaign in Kosovo, the air campaign in Kosovo involved forces that were about one-tenth the size of those that were committed to Desert Storm, but they used 100 times the bandwidth, bandwidth being an effective metric that's correlated with information.

If you compare the bandwidth requirements being used to support military operations in Iraq, for example, the bandwidth requirements were many times more than were required in Kosovo, reflecting the vast increase in needs, and indeed the bandwidth that we had was inadequate to the ability of our information-producing intelligence and command and control system to actually apply.

We have gone much more heavily into information dominated defense establishment which calls my attention to the other characteristic of U.S. defense modernization is the move towards net-

working defense platforms. It used to be the case that you could characterize military performance by comparing the military capacity of say a tactical aircraft and comparing it with the characteristics of an adversary aircraft, and by comparing those with the numbers and the proficiency of the crews, you could get a pretty good idea of how a campaign would work out.

But now the decisive metric of military performance is the performance of the network rather than the performance of the individual platform, which in turn is derived from the effectiveness of the use of information in those operations.

This couples to the industrial base in that the supply chain that produces information derived technology has become increasingly globalized. Indeed, a large fraction of this capability is now located outside of the United States, and these factors are illustrative of what is happening to the defense industrial base as the locus of technology moves out of the defense sector into the civil sector in terms of the underlying technologies that create the capabilities and that the capabilities of modern military force are increasingly described by the effectiveness of its use of information and the effectiveness of the way in which it's able to network its systems.

A few years ago, the Defense Science Board did a study that included an exercise of trying to look at what a potential adversary could do with a relatively modest investment of, say, five billion a year I believe was the figure for five years. What kind of capabilities could they create largely by investing in civil market technologies but systems engineering and integrating them in a clever way?

It turned out if the adversary focused on a class of defense investments that for want of a more complete descriptor can be called anti-access technologies like air defense, mine warfare and electronic warfare, things of that sort, you would have a very capable adversary with relatively modest investment because of the increasing impact of technologies that emerge outside of the defense sector, but when properly systems engineered, produce very powerful military effects.

This tends to reinforce the fact that process knowledge or know-how about how to put these otherwise mundane technologies together is becoming the heart of the industrial base, and there's a lot of detail surrounding that and I can discuss that in more detail.

We also, the Defense Science Board also has a study underway now with its counterpart organization in Britain and the British MOD trying to understand technologies that are developed in the civil sector—sorry—technologies that are important for national defense that will not be developed in the civil sector.

The Department of Defense has already started an industrial base program dealing with radiation-hardened solid state electronic components because of the fact that the civil market is unlikely to require these kind of technologies and they would not hence be available in this globalization of the supply chain that I described.

To the extent that this becomes or is an important characteristic of the way in which technology relevant to national defense evolves is a matter of public policy. The question of the degree to which the components of the defense industrial base will need to be treated

in some special way may emerge more rapidly than we had previously expected.

This is not to say the industrial base is disappearing by any means. The skill sets that are associated with converting these technologies into military capabilities are one that has a very slender claim on national resources.

I had the privilege to serve on the Commission on the Future of the Aerospace Industry, and it was quite clear from the evidence presented to that Commission that the ability of this industry to attract investment and to sustain the financial basis for its high technology performance is clearly at risk, and the factors that I know are of interest to this Commission are likely to create further problems in the future as more of these technologies migrate offshore and the U.S. civil industrial base tends to increasingly focus on knowledge generation rather than the creation of hardware.

That does pose a challenge for how the U.S. will be able to maintain its leadership and be able to sustain a capability to support the national strategy of maintaining a decisive technology edge in military performance.

Finally, the Defense Science Board did a study on the implications of globalization for the defense establishment a few years ago, and I have a copy of the executive summary of that report, and the chairman agreeing, I'd be glad to provide this for the record.

Chairman D'AMATO. We will put it in the record.

Cochair WORTZEL. Love to have that for the record.

Dr. SCHNEIDER. Okay. Since I know our time is very limited, I think I've given you some suggestions about how we see the challenges and some of the priorities that need to be addressed by the U.S. Government. I would be glad to respond to any questions or comments that you may have to offer.

Panel III: Discussion, Questions and Answers

Cochair WORTZEL. Thank you very much. I think China is an excellent example of a country that has learned to apply new technologies to make new weapon systems more effective in a lot of cases on old platforms. So your examples were very relevant.

Dr. SCHNEIDER. Yes.

Cochair WORTZEL. I'll start, and I'd like to ask if in your opinion the legislation on protecting and controlling dual-use technologies has kept up with advances in industry? Is legislation driving or preventing industry from moving forward?

Dr. SCHNEIDER. I tend to think that because the legislative authorities that created these regulations tended to be based on a model of defense modernization that no longer obtains, my expectation is that the legislation is likely to be an imperfect vehicle to stay on top of what's actually happening.

As I mentioned, the things like process knowledge are becoming much more important than knowledge of the hardware itself. We have a tactical radio program now underway, the Joint Tactical Radio System, that is so-called software enabled or software driven radio.

The hardware is pretty mundane. What creates its capabilities is the way the software causes the hardware to operate and so the industrial base that's really decisive for producing that piece of

equipment is the industry that generates the software for it and that can produce a radio that has three dozen wave forms that can operate in virtually every environment that you can think of.

And that's illustrative of what's going on. The globalization of the supply chain will produce a lot of components and subsystems for those radios that are by civil standards relatively mundane piece of equipment, but the software is exotic and the industry that creates that software is a national asset.

Cochair WORTZEL. Thank you. Commissioner Wessel.

Cochair WESSEL. Thank you, Mr. Chairman. Thank you, Mr. Schneider, for being here. It's a pleasure to see you again and we always learn from your participation. Appreciate it.

You talked about the changing nature of the military as it goes through its transformation strategies and the importance of information, bandwidth, et cetera, network centric. Increasingly, we're seeing the outsourcing of innovation. In fact, Business Week had a cover story about that a couple of months ago.

From the Defense Science Board, what has been the analysis, what are the concerns as we see R&D centers migrating? Our principal concern, of course, is China. How are you looking at those issues? What are the concerns?

Dr. SCHNEIDER. The R&D sector is a source of great concern, and we have focused on various ways of dealing with this. From the perspective of the defense sector, what is really important is the R&D that is specifically devoted to national defense, and this phenomena I described earlier of where the enabling technology tends increasingly to be created outside of the defense establishment, but the defense establishment then takes that technology, adds value to it in various ways, so that it can be adapted to a national defense mission.

This, trying to manage the R&D establishment when you're facing this kind of environment and the environment is changing so rapidly, is proving to be quite a challenge for the U.S. Government. The Base Realignment and Closure Commission that is now considering the infrastructure in the defense establishment, which includes laboratories, industrial facilities, as well as bases, has to come to grips with this in the sense that we need to make sure we have the right mix of facilities that we'll be able to support and stimulate R&D.

Indeed, we need to find ways in which we can stimulate the participation of companies that are not now in the defense sector so that they will be more willing participants in the defense sector, and being able to do that might be one of the opportunities we would have, to serve more as a magnet for some of the technology companies that are outside of the defense sector to start doing some work for the defense sector.

Admiral Art Cebrowski, who was until he retired in January the head of the Office of Force Transformation, observed that in the not too distant future, most of the military effects would be achieved by non-kinetic means. And that again reinforces the power of information, but suggests that many of these companies that are now allergic to working in the defense establishment need to be brought back and the R&D centers that will otherwise proliferate worldwide need to be strengthened in the U.S. as well.

Cochair WESSEL. Is there an additional concern, as you point out, that much of the R&D, much of the technologies that are being brought into the defense sector are initially done by the civil sector?

If Microsoft or somebody else does the technology with Chinese personnel in China, with a recognition that software now has tens of millions of lines of code, the opportunity for them to either have the countermeasures or in fact disabling technologies, I guess, backdoors, trapdoors, everything else, is that an increasing concern as this gets——

Dr. SCHNEIDER. Yes, it certainly is of great concern. The point I made earlier with respect to the radiation-hardened chips, where we have two facilities that are essentially subsidized by the Department of Defense, and dealing with this problem where you need, say, software written in a highly secure environment, that it probably has to be recognized that a premium price would have to be paid for it, and that you would have to continue to invest in the modernization so that it was able to stay abreast of the technology no less proficiently than the civil sector.

These are very expensive capabilities, however, and so great care needs to be invested in figuring out the ones that are truly critical to the national interest so that you can make sure you're investing your resources wisely.

Cochair WESSEL. Thank you.

Cochair WORTZEL. Thank you very much. Commissioner Mulloy.

Commissioner MULLOY. Dr. Schneider, thank you for being here. I think the last time I heard you testify was years ago when I was with the staff of the Senate Banking Committee. We were working on export controls and related issues.

Dr. SCHNEIDER. Yes.

Commissioner MULLOY. It's a pleasure to see you again. We have conducted hearings looking at China trade as part of a globalization process, and let me just lay out a couple of things. The multinational corporations because of the way the system is structured are driven by profit motives as they should be, but the way that the system is structured, they don't necessarily have to look out for the national interest; they have to look out for their survival and maintenance.

Secondly, foreign governments such as China and others understand this process and have implemented strategies to use market forces to move technology, industries, R&D, from here to there.

Thirdly, we had an interesting meeting with Dr. Howard yesterday on the semiconductor work that's been done by the Defense Science Board and you have an idea of the real problems that are in that area. My own sense in following this now for four years with this Commission is that this isn't just semiconductors. This is an enormous movement of industrial-based R&D technological capacities out of the United States to Asia with China a main player in all of this process now.

Do you have a sense that we need a larger national strategy to understand what's happening to us, and to try and figure out if we don't want it happening to us what we ought to be doing in terms of a national vision to guide ourselves on preventing it from happening?

Dr. SCHNEIDER. I think you've raised a very good and appropriate point. The underlying problem is that the economic incentives for globalizing the supply chain are omnipresent and are affecting almost every industry, and it is necessarily the case that what is an optimum solution for least cost production of software or least cost production of electronic equipment is not one that produces an effective security system and indeed a determined player can exploit the globalization of the supply chain.

The Science Board is trying in a focused way to identify some of the areas where we may need to focus some investment. For example, one of the characteristics in the computer industry, computer software industry is to emphasize large-scale parallel processing for the solution of most industrial and scientific and commercial problems.

As a result, the industry is producing these very large computers that process the input in parallel, but for solving some kinds of national security problems, say in cryptography by way of illustration, it may be the case that the more classic vector processing is the way in which the technology really needs to go. That's a hypothesis, not a studied answer, but if that turned out to be the case, and the civil sector was not going to require vector processing because its needs are met by parallel processing, then the government will need to find some way to provide the set of incentives for companies that are able to produce vector processing equipment to provide that for national security needs.

The problem is that the incentives or the disincentives are profound in the acquisition system at this point, and as a result many of the companies that have the capability are not prepared to offer their services to the Department of Defense because of the regulatory environment to which they are subjected which is part of the reason why we have high cost products.

Commissioner MULLOY. The Defense Science Board has come out with some recommendations dealing with semiconductors?

Dr. SCHNEIDER. That's right.

Commissioner MULLOY. Are you trying to think through the larger issue and come up with some broader vision to recommend to policymakers?

Dr. SCHNEIDER. My aspiration is to try and collect more evidence of what is happening. That is what are the consequences of the globalization of the supply chain, and what kind of things are going to be needed in the defense establishment? As I mentioned, the modernization themes are producing an extraordinary amount of dynamism in the needs of the defense establishment for technology.

We need to anticipate that rather than keep trying to catch up. So my aspiration is that this information as it is presented to the leadership and the Department of Defense and the Congress can come together on a strategy about how to deal with this because we are not going to be able to catch up in the way we are currently managing it.

Commissioner MULLOY. Well, this could be the beginning of a beautiful friendship, as they say in Casablanca, because we really should be working closely with you and we're trying to encapsulate a vision of what is happening and trying to make some recommendations.

Dr. SCHNEIDER. Good.

Commissioner MULLOY. So we look forward to working closely with you.

Dr. SCHNEIDER. Thank you, sir.

Cochair WORTZEL. Chairman D'Amato.

Chairman D'AMATO. Thank you very much, Commissioner Wortzel.

Good to have you here, Dr. Schneider, with your background and level of knowledge of these industries. The Chinese, of course, do engage in their own national strategy and of course support industries they regard as actually critical to the development of their economy. This is government-led although more and more private organizations involved, but government-led strategizing what they need to do and to acquire. We don't do that, of course, right now, but you were on the Commission on the Future of the Aerospace Industry.

We had a hearing in Seattle and had some members—Heidi Wood, for example, who you worked with on that Commission from New York—very, very interesting testimony. I believe that Commission reported, five years ago perhaps?

Dr. SCHNEIDER. Reported in 2003.

Chairman D'AMATO. Two years ago then.

Dr. SCHNEIDER. Yes.

Chairman D'AMATO. I was mentioning earlier on a paper that we've gotten done in March of this year on the aerospace industry, particularly on Boeing, by two researchers at the State University of New York in Buffalo, in which they claim that essentially the Boeing Company is moving technology offshore, particularly to Japan, in a way that is sacrificing the seed corn of the industry. For example, all the wing technology composites that have been done. And that the 787 aircraft, the only part that will be done exclusively, they claim, in the United States is the nose and almost all the rest of it is being done in Japan.

I'm assuming that that technology will become available to the Chinese over time as well. Now, here's a question of an industry that is absolutely central to our national security, an industry that is one of the jewels of the American industrial establishment, and the claim is being made that it's being moved offshore in a way that will destroy the industry. Why that is being done by this company is a mystery to me, if it's happening.

What is your feeling based on your experience on that Commission and this kind of danger? We talk about national strategy. Well, here's evidence of one industry. Would we want to have a national strategy dealing with the aerospace industry now? Is that where we're at with regard to this industry before we lose it entirely?

Dr. SCHNEIDER. One of the characteristics of the aerospace and defense sector is, as I say, the information and process knowledge is becoming a dominant part of the technology, and the distinction between producing the wing and designing the wing is a very important one. The knowledge of how you integrate all of the knowledge of aerodynamics and physics and material sciences and structural engineering and so forth to produce the wing is the seed corn.

The ability to bend metal or plastic, while it's certainly important, that's not where the core of the company's intellectual property or the national interest resides, and the problem of exporting the design capability or the capability to systems engineer, that is to bring in all of these disparate things to produce an effective unit or to integrate the components to produce an entire aircraft system, that's where the national seed corn is, and I think in trying to understand this, we probably need to disaggregate the question of where the tin is bent and where the design is created.

Chairman D'AMATO. Yes, I think that the question is whether or not the design and the integrative capacity is actually being moved to Japan. They would claim that it is.

Dr. SCHNEIDER. Yes. I don't have any specific knowledge of how that specific company is doing it, but I was describing the process in general.

Chairman D'AMATO. But let me just go back to the question I wanted to ask you, and that is if you were to find the evidence that a major national security industry was in jeopardy, semiconductors or whatever, what is the role of the United States government to correct that?

Dr. SCHNEIDER. Well, the U.S. Government already has legal authority to control the passing of technical information that would relate to those kinds of capabilities where it's a defense article.

Where it does not have the statutory authority at this point, as best I understand it, would deal in these areas of civil technology. So there's a public policy question to whether the government should try and regulate the transfer of technology in these civil applications. And I haven't studied the problem so I don't have any direct comment to make on whether or not that is wise, but in my career in the Department of State, I had responsibility for the munitions licensing system, and we were, as a matter of public policy, very careful about transferring technical information about systems engineering or systems integration, and we would sell an F–16, for example, that is sold as an unclassified system, but the knowledge of how you make the F–16 is classified, and the export of that knowledge is regulated.

Chairman D'AMATO. Yes. Thank you.

Cochair WORTZEL. Thank you. Commissioner Becker.

Commissioner BECKER. Thank you, Mr. Chairman. I have several questions. Steel has always been a core industry in the United States. As many nations, as they develop, the first thing any emerging country wants is to build a steel industry. It's vital for a lot of things. Do you consider steel a strategic manufacturing item?

Dr. SCHNEIDER. My expectation is that there are processes that are applied to certain types of steel that are unique to military applications. I'd say there's probably a large fraction of the steel sector is commodity type and does not have the same characteristic, but inevitably there are specific processes that are unique for military applications that are and should be protected.

Commissioner BECKER. It's generally thought that those processes in steel—it's not a very sophisticated process—is available anywhere from other sources.

Dr. SCHNEIDER. Yes.

Commissioner BECKER. In other words, could we stand to have the steel industry disappear from the United States?

Dr. SCHNEIDER. I think for many of the civil applications, probably the economics of the steel industry will determine its location. But say for specialized applications, my expectation is that we would intend to keep steel industry here for national security purposes.

Commissioner BECKER. This gives rise then to my next question. I've always felt that the economic security of the United States is inextricably attached to the national security of the United States. Commissioner Mulloy spoke about the huge transfer of industry out of the United States. One of those is classified as advanced technology products and where we used to run a surplus in this country, somewhere in the neighborhood of $30 billion.

Now, it seems like the Chinese are eating our lunch. We're running a deficit in the neighborhood of $40 billion, and this is over a period of seven years. So there's really been a transfer in advanced technology products of some $70 billion in this length of time. Can we have a healthy defense industrial base in the United States without having a healthy economic presence here in the United States?

Dr. SCHNEIDER. No. Of course, it's the national economy that's ultimately the source of our military power. There are very few precedents for a country being able to do much in the way of maintaining a comprehensive military capability without a strong national economy. So I think that's pretty widely recognized even though the amount of the national treasure that is required to produce an effective military establishment is declining because of the fact that it's actually becoming cheaper to maintain a powerful defense capability because of these advanced technologies.

Commissioner BECKER. We're seeing industry after industry disappear, that in and of itself the industry may not produce a military industrial base like textiles. We've had a lot of problems in getting the jackets that would protect our servicemen in Iraq because all of this disappeared from the scene in the United States. And this is stretched all the way through, but I'm even tying it in more than that. The infrastructure, bridges, roads, sewer systems, water systems, even educational. I think I'm asking you whether a healthy economic base is essential for us having a strong military?

Dr. SCHNEIDER. Yes. I think everything you've said is important to our defense establishment. The economy can't operate without a strong functioning infrastructure of all of the civil works you've just described.

I think the question for public policy is that you can't make the whole national economy part of the defense budget and there are certain core capabilities that defense establishment is going to need and those core capabilities are going to evolve over time as our needs evolve, and we need to find a way to come to grips with that, so that we are assured that even if the economics of specific industries or capabilities don't sustain an industrial base in the United States, that we face the fact that we may have to divert some of our resources to maintaining that capability, specifically for national security purposes, as I described the rad-hard chips case.

Commissioner BECKER. Thank you.

Cochair WORTZEL. Thank you. Commissioner Dreyer.

Commissioner TEUFEL DREYER. Thank you. Dr. Schneider, I found your testimony at one and the same time to be fascinating and chilling because here we have the globalization of the supply chain, which is pretty well impossible to stop, and at the same time, we have other countries' increasing ability to put, as you phrased it, mundane technologies together into a larger system.

That is giving them a military edge as well as a civilian technology edge, and it occurred to me that what we as the United States have typically done better than a lot of other countries in keeping ahead of the innovation curve. Now, however, I seem to see us falling behind on it.

So, in your opinion, rather than to try to pass legislation to stop things—and you've already given us a couple of excellent examples of legislation that inhibits rather than helps—should we not be trying to pass enabling legislation? If you think that's true, are there any specific suggestions you would have?

Dr. SCHNEIDER. Well, I think we need to better understand the disincentives that exist to innovation. I've been somewhat involved in the efforts that the Defense Department is making to cope with the phenomena of improvised explosive devices in Iraq and Afghanistan. These devices are cleverly made, typically using technologies from the civil sector, combined with bits and pieces of military ordnance to produce very lethal effects.

And I had an opportunity to see a term that I think your term of "chilling" would be appropriate. The al-Qaeda organization has moved its, the kind of activities it used to run on the ground in say Afghanistan in a pre-9/11 to cyberspace. They conduct all their training on the Internet. They have—I've seen a couple of videos where the ambushes of U.S. convoys are filmed and put on the internet for training purposes, and through this, they're able to see the measures that the U.S. Government takes to reduce vulnerability to countermeasures and within 24 hours are able to work on a fix to them.

So you see this cycle of innovation in this environment is something that we don't have the kind of luxury that we had in World War II where you see the Germans have the famous 88 guns so you come up with some ways to deal with it, and you can wait six months or 12 months.

Here these innovations are working on a much faster track than say the Defense Department acquisition system is able to respond, and so we need to look at wholly new ways of innovating in the defense establishment. I think it's probably too big a subject to try and take a bite out of here, but I think the slice that you're looking at about how the globalization of the technology base has become nearly universal.

The challenges it poses for U.S. security are intensifying and we need to begin to look at the institutional barriers that are creating these problems and not just at science and technology. We can generate the science and technology, but we often can't overcome the institutional barriers without some help.

Commissioner TEUFEL DREYER. Thank you.

Cochair WORTZEL. Chairman Robinson.

Vice Chairman ROBINSON. Thank you. First, I'd like to compliment Dr. Schneider for his exemplary record of government service, particularly your stewardship as Under Secretary of State for Security Assistance, Science and Technology, where I had the good fortune to work closely with you while at NSC at the time. It's a delight to have you here and this represents, of course, great value added for us.

Dr. SCHNEIDER. Thank you.

Vice Chairman ROBINSON. I would like to pick up on some of the recent examples you've just given and some of the content of your testimony. It's not just al-Qaeda that is seeking to use asymmetric warfare to put us at a disadvantage and keep us off balance. China itself is steeped in that kind of thinking, witness their emphasis on asymmetric warfare and more rapid military innovation.

At our hearings in Stanford in California, we should don't try to slow the Chinese technologically, just run faster ourselves. And, of course, we're also impressed with the way our own industrial base is evolving from core capabilities that were domiciled in the defense industry sector to the civil sector.

You raised the interesting public policy issue as to whether we are in a circumstance now whereby systems integration, design, and sophisticated networking, need to be increasingly safeguarded because of the rapidity with which China can apply these commercial capabilities to the military sector?

I think that this is something that the Commission would be interested in looking at. As you said, the critical technologies list and munitions lists as well as other safeguards may no longer be sufficient.

Dr. SCHNEIDER. Right.

Vice Chairman ROBINSON. I'll also be interested in your comment as to whether you think that it's time to look at some of these civilian transfers anew from that perspective? What are the other two or three priorities that we might be examining as to China's construction of its own defense industrial base designed to ultimately rival our own with a focus on some of these key processes and design questions that you've alluded to?

Dr. SCHNEIDER. Thank you, Mr. Robinson, for your generous remarks at the outset. I think you've pointed to some really vexing problems about this phenomena because the technologies that pose the most problem for us in the sense of migrating to end-users that we don't like also have the property that their location is really independent of geography. That is most of the work can be done anywhere. The infrastructure required to produce it is nominal because it's mainly mental constructs rather than physical assets, and I think we had an intimation of the problems 25 years ago when we faced the problem of controlling cryptologic products for export.

And there turned out to be a tremendous need internationally for cryptologic applications to financial services industry and to desktop boxes on TV sets and so forth, and U.S. restrictions led to migration of the people with the intellectual capability to produce cryptologic technology abroad, and as a result, we've had a very substantial deployment of these capabilities abroad.

So I'm not saying it's a reason not to do it, but I'm saying it's a very complex problem because of the way it's interwoven with economic incentives and the nature of this information dominated kind of technology that is so readily deployed to other markets.

Vice Chairman ROBINSON. Thank you.

Cochair WORTZEL. Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you very much and I join Chairman Robinson in acknowledging your contributions to our country and thank you for the work over the decades I think it is by now, but you have an institutional expertise and a substantive expertise that I think we all benefit from.

I was particularly interested in your observation about a focus on knowledge creation rather than on hardware. In April, we were out in Palo Alto. Secretary Perry testified in front of us, and he noted that one of his concerns about our technological future is that most of the research now is going into product development and not basic research, and that is frankly often out of basic research that we get a lot of innovations that nobody predicted because that's what they were looking for.

What are your thoughts are about that? If you all are looking at it and what kinds of measures need to be done in order to beef up basic research?

Dr. SCHNEIDER. It is a problem and in 2001 the Science Board tried to address some of this issue with the Department of Defense laboratories. What should they be working on?

As I mentioned, a lot of the enabling technologies are now produced in the civil sector. So there's no need for defense laboratories to begin to produce microprocessors or other kinds of information technology that are readily accessible in the defense sector, outside of the defense sector.

So the defense laboratories have tended to be focused on the application of advanced technology for military purposes and have not focused very much on basic technology, but it may be necessary for DoD to acknowledge the fact that there is a lot of technology that's now being produced in the civil sector that has applications to defense and focus on industry making that transition, perhaps by reducing some of the institutional barriers to more effective collaboration between the non-defense sector and the defense sector and getting the government laboratories to work in a more focused way on supporting some of the work in basic research and in collaboration with universities which are ultimately the source of a lot of this work.

But the basic research is clearly a problem. It's likely to be generally under funded, and it's compounded by the reluctance on the part of the Congress to sanction DoD expenditure on non-mission area R&D, and that has historically posed a limitation on how aggressively DoD produces or allocates funds to non-mission area work.

Commissioner BARTHOLOMEW. Thanks very much.

Cochair WORTZEL. Thank you. Commissioner Reinsch.

Cochair REINSCH. Thank you. I was going to thank you for your service to the country, too, Mr. Schneider, but it would be redundant, but it is sincere. You've spent a lot of time over many years

and devoted a lot of your energy to making our defenses better and I think we all are grateful for that.

Let me also apologize for missing much of your statement. As often happens, the exigencies of the moment trump a much more important discussion of the long-term. But you know how that works.

You referred in one of Larry's questions to spin-offs, the migration of civilian technology to the military sphere to deal with specific needs.

I wonder if you could speak for a couple minutes or less on the reverse, a spin-on, the migration of a defense product into the civilian sphere. In essence, I think what we're seeing in a number of cases—I think night vision is the most prominent——

Dr. SCHNEIDER. Right.

Cochair REINSCH. —is where the manufacturers or the developers, whatever you want to call them, seeing a limited market both because of limited need in the military and also because of export controls that limit other militaries' access to the same goods for security reasons, begin to look around for civilian products they can make that would escape these kinds of limitations.

Dr. SCHNEIDER. Right.

Cochair REINSCH. How do we deal with that? And how do we identify points at which the government can release that technology, acknowledge the civilian application and let it go for those purposes without compromising security?

Dr. SCHNEIDER. Well, I think those are important questions and one of the things that I think is especially interesting about the current time in defense technology is it's the first time I think since the '50s where defense requirements are in a number of areas considerably more demanding than civil applications.

It had been the case through the '60s, '70s, and '80s in an increasing way, that defense lagged behind civil technology requirements.

Cochair REINSCH. You mean quality or quantity?

Dr. SCHNEIDER. It's performance. DoD has a relatively minor share of the information technology market, for example, as a buyer of information technology or information technology services. But DoD has a unique requirement in that they need a vast area, physical area of situation awareness in near real time. So if you dip your credit card in a machine to validate your eligibility for credit, you can wait 15 seconds, but in some DoD applications, they need to know everything in 15 nanoseconds.

This is producing a requirement for bandwidth, processing time, and other characteristics of the management of data that are well in advance of civil needs, and there are some very good opportunities for the spin-off of these advanced defense applications to the civil market. The institutional arrangements that permit this to happen, though, are let's say imperfect, and because you have a situation that didn't exist in the '50s, which is the source of the technology is the civil sector, but these technologies are modified in ways for military applications that produce capabilities that are far in advance in many cases of civil markets.

So the underlying technology is now civil in origin, but the way in which the technology has been mutated in the defense sector has

given it new capabilities, and it seemed to me that there may lie a basis for accelerating the transfer of technology from defense to the civil sector because the underlying technology still is originating from the civil sector.

That's a rather elliptical answer to a straightforward question, but sometimes it's not so easy to answer your complex questions.

Cochair REINSCH. I think I'm going to puzzle over that one awhile.

Dr. SCHNEIDER. Okay.

Cochair REINSCH. And surrender the rest of my time. Thank you.

Cochair WORTZEL. Dr. Schneider, thank you very much for your testimony today. It's been a great help to all of us and we appreciate your taking the time to meet with us and your availability.

Dr. SCHNEIDER. Thank you. Great.

Cochair WORTZEL. We're taking a break now.

Chairman D'AMATO. We'll recess for lunch and reconvene at 1:30 here.

[Whereupon, at 12:40 p.m., the hearing recessed, to reconvene at 1:40 p.m., this same day.]

AFTERNOON SESSION, 1:40 P.M.
THURSDAY, JUNE 23, 2005

PANEL IV: THE AEROSPACE, MANUFACTURING TECHNOLOGY AND SPECIALTY METALS INDUSTRIAL BASE

Chairman D'AMATO. We'll continue our hearing on U.S.-China trade impacts on the U.S. defense industrial base. Commissioner Wessel will conduct the afternoon hearing. Commissioner Wessel.

OPENING STATEMENT OF COMMISSIONER MICHAEL R. WESSEL HEARING COCHAIR

Cochair WESSEL. Thank you, Mr. Chairman. Good afternoon and welcome back to the Commission's activities on the U.S.-China trade impacts on the U.S. defense industrial base. U.S.-China trade and investment has different impacts on a variety of industries that serve as the basis of the U.S. defense sector. It's for that reason that we'll take a look at these specific industries in two panels this afternoon.

First, we will examine the aerospace, manufacturing technology and specialty metals industries. Much of the U.S. military might relies on aerospace technology and the industry is characterized by high skill, high-wage jobs. In 2004, the aerospace industry contributed to 25 percent of all new manufacturing jobs here.

Additionally, aerospace is one sector where the U.S. enjoys a positive trade balance with China. China has made acquisition of aerospace technology as a high priority. Beijing is strongly committed to developing this area and investing heavily in U.S. aerospace firms.

China is looking to acquire foreign technology to assist its commercial and military aerospace pursuits. Mr. Pierre Chao, Director of Defense Industrial Initiatives at the Center for Strategic and International Studies, is here today to discuss globalization of the defense industrial base and the U.S.-China trade and investment relationship in the aerospace sector.

Next, we have Dr. Paul Freedenberg, Vice President for Government Relations at the Association for Manufacturing Technology. Congress closely watches the manufacturing technology industry. The strength of our manufacturing sector has been an issue for national debate for quite some time and was a key issue in last year's Presidential race.

With this in mind, Dr. Freedenberg's testimony is one I know Congress will pay particular attention to.

Closing out our first afternoon panel will be Dr. Jack Shilling, Executive Vice President of Corporate Development and Chief Technical Officer for Allegheny Technologies, Inc., of Pittsburgh, Pennsylvania, to discuss the specialty metals and specialty steel industry.

Dr. Shilling has testified before the Senate and House Steel Caucus that specialty metals including specialty steel are, quote, "essential elements of virtually every U.S. military platform."

As China's demand for these materials rises and it appears prepared to secure supply through global acquisitions, competition for this metal will increase. What will be the availability and price consequences for U.S. defense needs?

In our last panel today, we will look at the semiconductor, information technology, and shipbuilding industries. The Defense Science Board Task Force on High Performance Microchips completed a study earlier this year on the security of the Defense Department's supply of advanced integrated circuits.

Last year, the Defense Department contracted with IBM to ensure a trusted foundry. This highlighted the importance of integrated circuits to our nation and the risk offshore microchip manufacture and design has on national defense. We are pleased to have here today Dr. William Howard, Chairman of the DSB Task Force on High Performance Microchips, to discuss his findings and recommendations on this issue.

Next, we will have Dr. Jim Lewis, Senior Fellow and Director of the Technology and Public Policy Program at the Center for Strategic and International Studies. Dr. Lewis will discuss information technology in today's current network-centric defense structure, which is a key issue in the Department of Defense's military transformation plans. Highly advanced information technology is critical to defense communications. Yet the IT industry is not motivated by defense sector needs. Rather, IT innovation is moved by commercial factors. How has globalization of the commercial IT industry affected the IT industry's responses to defense needs? This is a key issue we'll discuss.

Finally, today, we'll have with us Ms. Amy Praeger, Director of Legislative Programs for the American Shipbuilding Association. The shipbuilding sector is an important one. We have already seen consolidation of the U.S. shipbuilding industry. We have seen Japanese shipbuilding dominate in this sector. Now, China is expanding in this area to meet its own needs and others.

Last month, news reports indicated that the British Royal Navy's new supply fleet could be built in China. The rise of China as a shipbuilding power potentially has enormous implications for force projection and when we consider its naval interests in the Taiwan Straits.

Before we turn to our panelists, I know that the three co-chairs of today's hearing want to thank all the staff and their work. We appreciate it. Having worked with staff on Capitol Hill for more than two decades, I know what it's like to be behind the curtain and we wouldn't be here today with the witnesses and the preparation were it not for the staff.

So with that, we will turn to Mr. Chao and look forward to your testimony.

[The statement follows:]

Prepared Statement of Commissioner Michael R. Wessel
Hearing Cochair

Good afternoon and welcome back to the U.S.-China Economic and Security Review Commission's hearing on the U.S.-China trade impacts on the U.S. defense industrial base. U.S.-China trade and investment has different impacts on a variety of industries that serve as the basis of the U.S. defense sector. It is for that reason that we will take a look at these specific industries in two panels this afternoon.

First we will examine the aerospace, manufacturing technology, and specialty metals industries. Much of the U.S.'s military might relies on aerospace technology and the industry is characterized by high-skill, high-wage jobs. In 2004, the aerospace industry contributed to 25 percent of all new manufacturing jobs. Additionally, aerospace is one sector where the U.S. enjoys a positive trade balance with China. That said, China has made acquisition of aerospace technologies a high priority. Beijing is strongly committed to developing this area and investing heavily in U.S. aerospace firms. China is looking to acquire foreign technology to assist its commercial and military aerospace pursuits. Mr. Pierre Chao, Director of Defense Industrial Initiatives at the Center for Strategic and International Studies is here today to discuss globalization in the defense industrial base and the U.S.-China trade and investment relationship in the aerospace sector.

Next, we have Dr. Paul Freedenberg, Vice President for Government Relations at the Association for Manufacturing Technology. Congress closely watches the manufacturing technology industry. The strength of our manufacturing sector has been an issue for national debate for quite some time and was a key issue in last year's Presidential. With this in mind, Dr. Freedenberg's testimony is one I know Congress will pay particular attention to.

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Finally, today, we have with us Ms. Amy Praeger, Director of Legislative Programs for the American Shipbuilding Association. The shipbuilding sector is an important one. We have already seen consolidation of the U.S. shipbuilding industry.

And have seen Japanese shipbuilding dominate in this sector. Now, China is expanding in this area to meet its own needs, and others. Last month news reports indicated that the British Royal Navy's new supply fleet could be built in China. The rise of China as a shipbuilding power potentially has enormous implications for force projection and when we consider it's naval interests in the Taiwan Straits.

So with that, let me thank you all for being here today and let's begin with Mr. Chao.

STATEMENT OF PIERRE A. CHAO
DIRECTOR OF DEFENSE INDUSTRIAL INITIATIVES
CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES,
WASHINGTON, D.C.

Mr. CHAO. Commissioners, thank you for the opportunity to address you on the issue of aerospace and the role of U.S.-China trade. What I thought I'd do is make some quick opening remarks, answering the questions that have been raised and then open it up for questions.

The defining element of the relationship between the military aerospace industry and DoD over the last ten or 15 years has clearly been the decline and rise again of the defense budgets. But the real change that has occurred has been the reduction in the number of new program launches.

If an increase in defense budget dollars improves the health of an individual company, the health of the industry is driven by the number of points of competition. And so when we've reached the stage where the U.S. is designing only one new fighter, it doesn't take a genius to figure out how many design teams that can ultimately support.

Looking back at the 1990s, there was a dramatic consolidation of the military marketplace—going from nine military aircraft manufacturers, down to three. This has been paralleled in the broader defense marketplace, with 175 companies collapsing into the top five defense contractors that exist today.

The same phenomenon, the search for points of competition, has also driven the behavior of the second and third tiers of the industry—the major subcontractors and component manufacturers. Once again, the ability to take a new technology or development, say a new hydraulic valve or a new engine, and install it on a platform, becomes that much more critical. With fewer points of competition and fewer new platforms to put equipment on in the United States, the subcontractor tier has expanded globally in the search for opportunities. Where we have seen the most amount of activity has been in the commercial marketplace, again outside the U.S., and in particular the regional aircraft marketplace. For example, where Brazil and Canada have become major players in regional aircraft and most of the major Asian nations have been looking at creating an indigenous regional aircraft capability.

And so this desire to find points of competition is the primary driver of a company behavior that you want to focus on. Added to this behavior are the trends in government and company research and development which have been declining across the. Government S&T has been in decline, as the near-term pressures of fighting a war compete with long-term investments; the lack of, frankly, strong institutional champions for long-term investments within the Department of Defense in those battles; and an R&D that's mostly focused on risk mitigation of existing program. There's been

a loss of our technological seed corn and the regeneration of that seed corn.

This has been paralleled on the corporate side where we've seen internal research and development in the defense industry decline from about four percent of revenues down to about 1.5 percent. This has been partly driven by the notion that if there is uncertain demand, it's hard to make a long-term investment. The old bargain of take it on the chin in R&D and you'll make it up in long production runs has also been fundamentally broken and so the economic incentives to reinvest is that much more difficult. Therefore, wherever there is an opportunity to chase after R&D opportunities offshore, the industry is driven towards them.

It implies that if you're looking for solutions, examining who is the institutional champion for long-term investment within DoD, let alone broader government, becomes something to examine. Reviewing the incentives that we put in place for industry to undertake long-term research and development is another good topic to examine. Finally, policies in terms of creating as many points of competition in order to keep the industry healthy becomes a third area of examination.

Overall, when you look at the offshoring of work in military aerospace, I would argue that at the prime contractor level it's been fairly modest. It's been primarily driven by offsets, by the push towards jointly developed programs, which in most cases have been undertaken with close allies. Where you really see the phenomenon of offshoring has been in the commercial marketplace, which is far more globalized than the military market, and in the more commodity-like products. The further down the supply chain you go, the more global it looks, the more global it has become.

As far as the issue of globalization and trade is concerned, I would submit to you that there are probably other deeper issues in the broader defense industrial base than let's say in the commercial aircraft marketplace.

It's been interesting to see that the opportunities that China has had to draw that military aeronautical technology to date have primarily come from the Russian industry. And if the U.S. industry thinks it has issues, I don't think any CEO would want to swap their position with that of a Russian aircraft manufacturer. The Russians are stuck with the dilemma of trying to prop up their industry and the bulk of the technology flowing to date to China, particularly aeronautical/airframe technologies and engine technologies has been from Russia.

As far as the ability to watch and monitor what's been going on is concerned, there are a series of reports such as the offset reports and other DoD reports. The industry also tracks the internationalization of the supply chain fairly well because they have traceability of parts and liability issues. But once you get below the third tier, it gets a bit amorphous, and you get into the traditional debate between the cost of tracking that information versus the utility of the information.

Ultimately, if you want to examine the impact U.S.-China trade has had from a military aerospace technology perspective, you must really think about the triangle between Russia, their relation-

ship with China and the relationship with the rest of the world - Europe, Canada and Brazil.

I've also noticed an interesting phenomenon worth mentioning, despite the fact that China is a very large and attractive market, there is a certain amount of self-censorship amongst the industry. There is particularly a concern over the lax intellectual property laws that are in place.

So in what I suspect will be one of the supreme ironies of our age, as China improves its intellectual property laws, as we want them to, it will lift that self-censorship in the industry that makes them cautious about what kinds of technologies that they transfer into China today.

Cochair WESSEL. Mr. Chao, if you could sum up, please.

Mr. CHAO. My last comment relates to the areas of capabilities that China is looking to improve that can't be provided by Russia. It's been focused mostly on improving the quality of manufacturing and their processes rather than the actual product technologies.

The area where they do lack expertise has been in electronics and avionics, which is again where they've been trying to do that upgrade that you discussed.

[The statement follows:]

Prepared Statement of Pierre A. Chao
Director of Defense Industrial Initiatives
Center for Strategic and International Studies, Washington, D.C.

How has the relationship between the aerospace industry and DoD changed? How has this affected R&D and readiness? What should the USG do to deal with shortcomings?

- Last 15 years marked by:
  - Post-Cold War drop and 911-related upramp in defense spending
  - Fewer new program starts (in military and commercial aerospace)
  - Which drove consolidation of prime contractors (see support slide #1)
    - Increasing budget dollars drives health of companies, numbers of programs drives the health of the industry (see support slide #2)
  - Has and is driving the major subsystem suppliers (avionics, engines, structures, hydraulics, etc.) to look overseas for new program launches to deploy new technology (for example growing regional aircraft market driven by Canada and Brazil, and strong interest in Asia)

How has the relationship between the aerospace industry and DoD changed? How has this affected R&D and readiness? What should the USG do to deal with shortcomings?

- Last 15 years marked by (cont'd):
  - Government science and technology and company independent R&D in decline (see support slide #3 and #4)
    - Government investment
      - Near term pressures of the war versus long term investments
      - Lack of strong institutional champion for long term investments
      - R&D mostly focused on risk mitigation of existing programs
    - Industry IR&D
      - Uncertain demand makes it hard to undertake investment
      - Old bargain of accept low margins for R&D and make it up in long production runs is broken

How has the relationship between the aerospace industry and DoD changed? How has this affected R&D and readiness? What should the USG do to deal with shortcomings?

- What should USG do?
  - Strengthen institutional champion for long term investment—raise DDR&E to Principle Deputy status in AT&L

- Review margin policy related to R&D
- As much as possible, create more points of competition
  - Spiral development with open architecture allows for more points of competition
  - Experimentation programs
  - Avoid going to joint programs too early

Does offshore manufacturing in the aerospace industry detrimentally affect the ability of the U.S. to engage rapidly and effectively if it becomes involved in armed conflict?

- Military aerospace
  - Offshoring limited in military aerospace, primarily driven by
    - Offsets (impact mitigated by using indirect offsets)
    - Use of leading foreign technology (head up displays for example)
    - Jointly developed programs (such as JSF) being done with closest allies like the U.K.
- Commercial aerospace more globalized than the military aerospace market
  - The more commodity-like or simpler the work, the more global (aerostructures for example)
- The further down the tiers of suppliers, the more inherently global
- To date, globalization has increased the list of potential suppliers
- There are other areas of the defense-industrial with bigger problems

What is the process for monitoring the impacts on the U.S. defense industrial base and, in turn, on U.S. security when U.S. firms outsource work abroad for defense contractors?

- Government reporting
  - Offsets reports
  - DoD reports on uses of foreign components
- Industry
  - Tracking of suppliers/parts to comply with "traceability of parts"/liability issues
- Less visibility once you go below 2nd/3rd tier
  - Trade off cost of tracking the information versus utility of the information

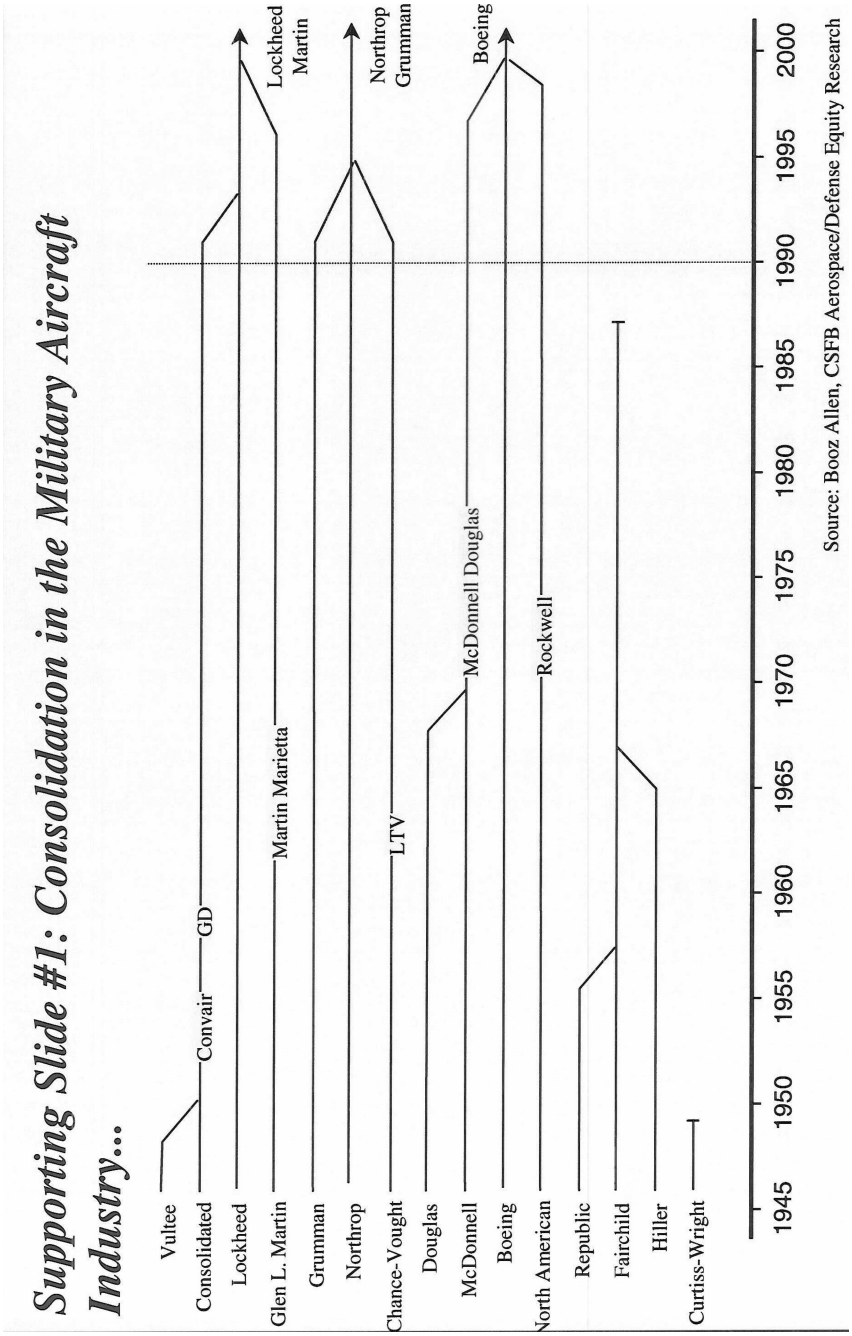
How has U.S.-China trade changed the aerospace portion of the defense industrial base? What trends do you see for the next five years? How can potential problems be prevented?

- No trade with China on military aerospace
  - China has been obtaining its military aerospace technology from Russia
- Commercial aerospace
  - China is one of the largest and fastest growing markets for commercial aircraft (large commercial and regional aircraft)
  - China leveraging this to attract aerospace manufacturing
    - Mostly aerostructures and engine technology to date
- China will continue to be a large, attractive market
  - Lax intellectual property protections limits what companies are willing to place in China (irony is that as IP laws strengthen, the rationale for self-restraint lessens)

Specifically, how is China attempting to improve its aerospace capabilities through commercial trade with the U.S. and others?

- In aerospace, particularly military, China is obtaining world class aeronautical expertise from trade with Russia
  - Commercial aerospace technology available from multiple sources—Canada, Brazil, Europe, U.S.
- Product technology being provided by the Russian
  - Interaction with other suppliers improving *quality* of manufacturing, processes, etc.
- Electronics/avionics expertise lacking from Russia, area of interest and focus on the part of China

Supporting Material



Supporting Slide #2

Fewer New Large Platform Programs, Supports Fewer Competitors

Combat Aircraft

	New Program Starts	No. Suppliers End of Period
1980-1989	6	7
1990-1999	3	3
2000-2003	0	2

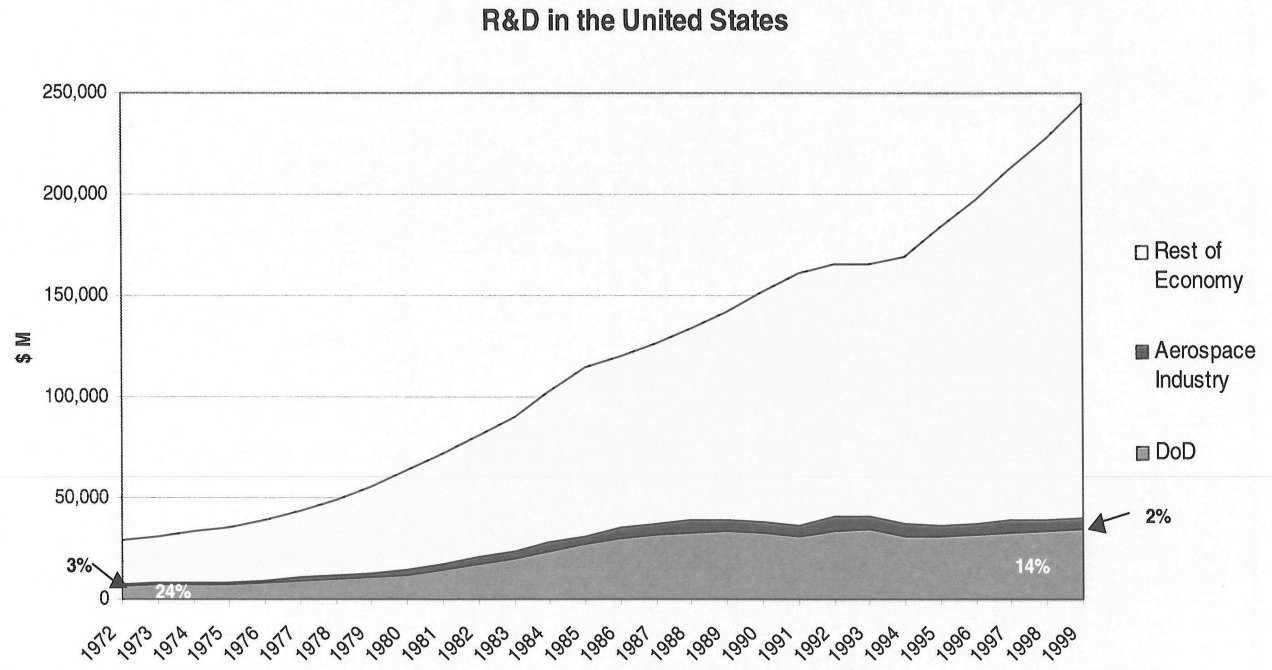
And Vice Versa…

Uninhabited Aerial Vehicles

	New Program Starts	No. Suppliers End of Period
1980-1989	8	8
1990-1999	14	21
2000-2003	9	29

Source: DoD, Janes Defense, FAS, Global Security, DMA Database

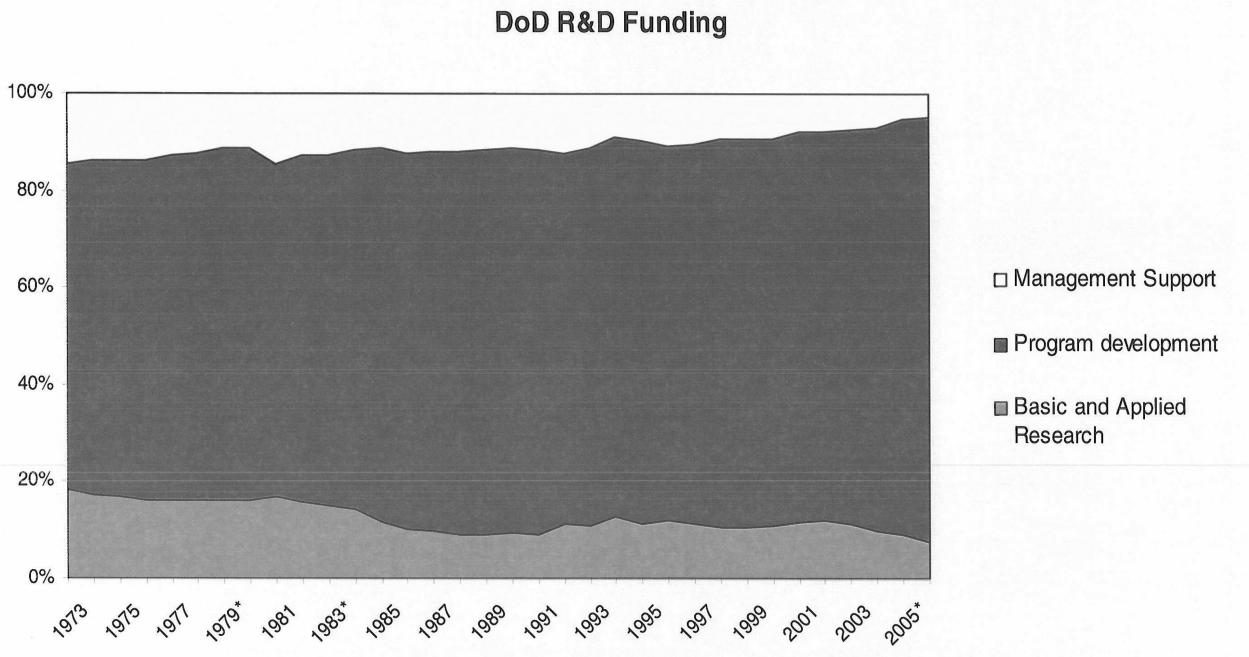
Supporting Slide #3: DOD Proportion of US R&D Spend is Shrinking



Sources: National Science Foundation, AIAA, CSIS Analysis

Notes: 1) Owing to lack of general data, the Aerospace Industry has here been used as a proxy for the defense industry

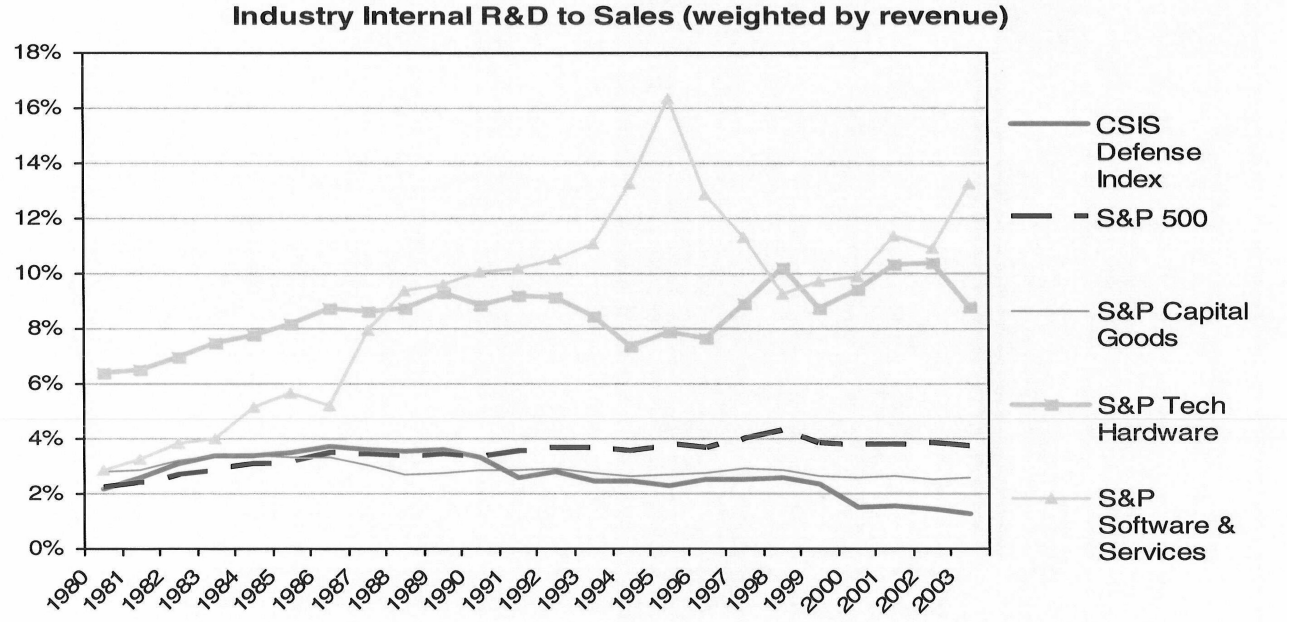
Supporting Slide #4: With Basic/Applied Science Also Shrinking . . .



Sources: National Science Foundation, CSIS Analysis

Notes: 1) Figures for 2004 and 2005 are estimates only

Supporting Slide #4: Company Internal Research & Development in Decline Due to Fewer Opportunities, Low Returns and Disincentives



Sources: FactSet, S&P Compustat, CSIS Analysis

Cochair WESSEL. Thank you. Dr. Freedenberg.

STATEMENT OF PAUL FREEDENBERG
VICE PRESIDENT FOR GOVERNMENT RELATIONS
THE ASSOCIATION FOR MANUFACTURING TECHNOLOGY (AMT)
WASHINGTON, D.C.

Dr. FREEDENBERG. Thank you. Today, I'm testifying on behalf of AMT, the Association for Manufacturing Technology, where I'm Vice President for Government Relations, and I'd like to talk about the state of the U.S. machine tool industry and how this affects our nation's defense industrial base.

A bit of history is useful. In 1986, after five years of steady loss of domestic market by the U.S. machine tool industry, President Reagan took action to limit foreign machine tool importation into the United States under the authority of the Trade Act of 1962, which, authorizes the limitation of imports for national security purposes.

That, by the way, was the first time it was done for an industry. President Reagan initiated negotiations with Japan and Taiwan, two countries with the fastest growing machine tool sales to the U.S., to limit their importation. Justified by the threat to our national security that the loss of the machine tool industry would cause, five-year, subsequently seven-year, voluntary restraint arrangements were negotiated successfully with both Japan and Taiwan in six key categories of machine tools.

This action and the industry rebuilding that it enabled preserved the domestically produced market share at approximately 50 percent over the next decade.

Now, the justification for negotiating those VRAs was the potential loss of domestic capacity to manufacture machine tools. It was felt that this would endanger U.S. Government's ability to mobilize in the event of a national emergency. At the time of this trade action, our defense strategy contemplated the need for the U.S. armed forces to be able to fight two and one-half wars simultaneously.

The calculation behind the VRAs was that without a substantial machine tool base, there would be insufficient surge capacity to respond to an emergency mobilization.

I was, at that time, the Assistant Secretary for Trade Administration, and I negotiated those VRAs. So I'm very much aware of what the logic was. The current defense planning no longer contemplates the need for fighting two and one-half wars simultaneously. Indeed Defense Department officials have stated publicly that the current war-fighting scenario contemplates a "come as you are" war, with re-supply dependent on whatever happens to be in the U.S. defense industrial base at the time of the initiation of hostilities, so-called "off the shelf," with re-supply significantly aided by the manufacturing capacity of our allies.

In other words, manufacturing capacity to build weapon systems in the event of an emergency would either come from the existing capacity, or it would be imported into the United States, or as an acceptable alternative it would be made offshore as needed.

The current plan does not seem to anticipate disrupted supply lines, a concern that existed during the Reagan administration and

was an integral part of all previous Administrations' war planning. That's something we discussed briefly at lunch.

During any possible conflict the President has the authority to invoke the Defense Production Act, which gives him the authority to interrupt domestic consumer production and institute priority production for national security mobilization priorities.

For example, in 1991, the DPA was invoked to divert machine tools from commercial production to defense production. However, as was demonstrated by the problems created when the Swiss manufacturer of a component of the Smart Bomb refused to ship to the Defense Department on a priority basis, the authority of the DPA ends at our nation's borders. And that's an important point to be remembered.

Now, let me turn to another issue, which is the state of the machine tool industry today. The simple answer to the question of what's wrong with the machine tool industry today that many of our members give is that in too many cases their customers have disappeared.

When our member companies go to make their sales calls, they find their traditional manufacturing customers either closed, moved to another country, most likely China, or else unwilling to make the new investment in sophisticated and productive equipment that's necessary to remain competitive in today's manufacturing marketplace, because of the uncertainty of manufacturing in the U.S.

The machine tool industry saw its domestic market share shrink by almost 60 percent from 1998 to 2002, and that was not just U.S. producers. That's the demand for machine tools in the United States. Last year it rebounded with the growth of 35 percent, but it remains 40 percent below its peak year of 1998. I would emphasize that not just our member sales but the sales of all machine tools in the U.S. diminished from a high of $8 billion to last year's mere $5 billion.

That's meant that despite the desire of our membership to retain skilled workers, we've seen employment shrink 33 percent to 38,500 workers.

To add to the domestic woes, foreign penetration of the U.S. market has increased by 15 percentage points to a level of 70 percent as a result of diminished market abroad and fierce competition for the last remaining machine tool market in the world. Perhaps some found it inevitable, but I still find it surprising and disheartening to point out that in 2002, China's machine tool sales passed the United States in the process of becoming the largest consumer of machine tools in the world.

Commissioner BRYEN. You're talking about?

Dr. FREEDENBERG. I'm talking about the total consumption of tools.

Commissioner BRYEN. When you said China surpassed the U.S., I just wanted to clarify what you mean. Do you mean in terms of Chinese exports of machine tools or consumption?

Dr. FREEDENBERG. No, Chinese consumption inside of China.

Commissioner BRYEN. Thank you.

Dr. FREEDENBERG. That's an indication of industrial activity. In another talk, I've also mentioned that they passed us in foreign di-

rect investment in 2003, although we came back in 2004. But the point is they were way ahead in the area of—I see my time is nearly up.

Let me summarize. The major point is that U.S. machine, the health of the industry is related directly to the health of the U.S. economy, and I go through a number of challenges that the U.S. machine tool industry has to meet, but the major one is the health of the economy and the trade status or trade relationship.

I would argue that the most important one is the dollar-yuan relationship. Last year, our trade deficit was $162 billion, largest bilateral in the world, and those who tell you, as we heard earlier, of the increase in exports to China, those who tell you that it's self-correcting, I'd point out that U.S. imports from China have been growing at more than twice the rate of U.S. exports to China, and when you start with a larger base, with 162 billion versus $35 billion, the increase, the gap is going to continue widening.

If the estimates are correct and the Chinese yuan is undervalued, which they themselves admit at this point, that's going to continue to be a problem. The solution ultimately is to engage them in negotiations, which they have been avoiding up till now, avoiding in terms of serious engagement, and to fix this problem. It's the only way, and it's not just related to our trade relationship, which can be seen as isolated; it's related to the strength of industry and, therefore, the strength of the defense industrial base, which depends on industry, machine tools being a very key part of it.

The reason I started with the history of President Reagan, Reagan's action was with the machine tool industries, the core industry from which you make your weapons systems, and if you don't have a strong industrial base to start with, you don't have a machine tool industry feeding it, and you are not going to have a strong defense industrial base ultimately.

I'll stop at that point and take your questions.

[The statement follows:]

Prepared Statement of Paul Freedenberg
Vice President for Government Relations
The Association For Manufacturing Technology (AMT), Washington, D.C.

I am testifying today on behalf of AMT—The Association For Manufacturing Technology—where I am the Vice President for Government Relations. AMT was founded in 1902 as the National Machine Tool Builders' Association and represents more than 350 manufacturing technology providers located throughout the United States, almost the entire universe of machine tool builders who operate here. Most of them would be classified as small businesses, with only a dozen or so having more than 500 employees. Today, I would like to talk about the state of the U.S. machine tool industry and how this affects our nation's defense industrial base.

First, we need to look at the machine tool industry in the United States and its role in defense activities. It would be misleading to look merely at the number of machine tools sold to the Defense Department by AMT companies, which was a mere $67 million in 2003 **(Item 1)**. A more significant number is the amount of machine tool consumption represented by companies participating in U.S. defense contracts, which accounts for approximately $674 million in sales, approximately 14 percent of total machine tool sales. Those are the companies that could be considered part of the U.S. defense industrial base.

A bit of history would be useful. In 1986, after five years of steady loss of the domestic market by the U.S. machine tool industry, President Ronald Reagan took action to limit foreign machine tool importation into the United States, under the authority of the Trade Act of 1962, which authorizes the limitation of imports for national security purposes. President Reagan initiated negotiations with Japan and Taiwan, the two countries with the fastest growing machine tool sales in the United

States, to limit the importation of their machine tools. He also informed Germany and Switzerland that their exports of machine tools into the U.S. would be monitored in order to ensure that those countries did not take advantage of Japan's and Taiwan's restraint. Justified by the threat to our national security that the loss of the machine tool industry would cause, five-year (subsequently extended to seven-year) voluntary restraint arrangements ("VRAs") were successfully negotiated with both Japan and Taiwan, who froze their market share in six key categories of machine tools at pre-1985 levels **(Item 2)**. This action and the industry rebuilding that it enabled preserved the domestically produced machine tool market share at approximately 50 percent over the next decade.

The justification for negotiating these VRAs was that the potential loss of the domestic capacity to manufacture machine tools would endanger the U.S. Government's ability to mobilize in the event of a national emergency. Machine tools, which are the principal ways that we cut, shape, and form metal, are considered such a key factor in the production of weapons systems that this unprecedented trade action was felt to be justified by a free trade-oriented President.

At the time that this trade action was taken, our defense strategy contemplated the need for the United States armed forces to be able to fight two and one-half wars simultaneously. The calculation behind the VRAs, based on a simple input-output model, was that without a substantial machine tool base, there would be insufficient surge capacity to respond to an emergency mobilization. During the 1982–1986 time period, the trend lines were definitely pointing to a loss of the core machine tool capacity necessary for an appropriate response.

Based on public testimony and published reports, it is my understanding the current defense planning no longer contemplates the need for fighting two and one-half wars simultaneously. Indeed, Defense Department officials have stated publicly that the current war-fighting scenario contemplates a "come as you are" war, with re-supply dependent on whatever happens to be in the U.S. defense industrial base at the time of the initiation of hostilities ("off the shelf") with re-supply significantly aided by the manufacturing capacity of our allies. In other words, manufacturing capacity to build weapons systems in the event of an emergency would either come from existing capacity, or it would be imported into the United States, or, as an acceptable alternative, it would be made off-shore as needed. The current plan does not seem to anticipate the threat of disrupted supply lines, a concern that existed during the Reagan administration and was an integral part of all previous Administrations' war planning.

During any possible conflict, the President has the authority to invoke the Defense Production Act ("DPA"), which gives him the authority to interrupt domestic consumer production and institute priority production for national security mobilization priorities. For example, in 1991 the DPA was invoked to divert machines from commercial production to defense production. However, as was demonstrated by the problems created when the Swiss manufacturer of a component of the Smart Bomb refused to ship to the Defense Department on a priority basis, the authority of the DPA ends at our nation's borders.

Now I will turn to another issue—the state of the machine tool industry today. The simple answer to the question of "what is wrong with the machine tool industry today" that many of our members give is that, in too many cases, their customers have disappeared. When our member companies go to make their sales calls, they find their traditional customers either closed, moved to another country—most likely China—or else unwilling to make the new investment in sophisticated and productive equipment that is necessary to remain competitive in today's manufacturing marketplace, because of the uncertainty concerning the future of manufacturing in the United States. Doing nothing is not a rational option. Investment in productive equipment is the only counter to the low labor costs offered by China. Yet the do nothing option is what too many companies are choosing today.

My industry, the machine tool industry, saw its domestic market shrink by almost 60 percent from 1998 to 2002. Last year it rebounded, with growth of 35 percent, but it remains 40 percent below its peak year of 1998 **(Item 3)**. I would emphasize that not just our members' sales but all sales of machine tools in the United States diminished, from a high of almost $8 billion in 1998 to last year's sales of a mere $5 billion. That has meant, despite the desire of our membership to retain skilled workers, we have seen employment shrink 33 percent to 38,500 workers from a high of 61,500 workers during that same five-year period **(Item 4)**.

To add to domestic woes, foreign penetration of the U.S. market has increased by 15 percentage points, to a level of 70 percent **(Item 2)**, as a result of a diminished market abroad and fierce competition for one of the last remaining open machine tool markets in the world. Perhaps some saw it as inevitable, but I still find it surprising—and disheartening—to point out the fact that in 2002 China machine tool

sales passed the United States in the process of becoming the largest consumer of machine tools in the world **(Item 5)**. Last year, China's machine tool consumption was almost 60 percent above that of the United States **(Item 6)**. Just as disheartening is the fact that the machine tool consumption trend lines continue to head in opposite directions for our two countries. Indeed, this is a troubling indicator of manufacturing's decline in the United States.

As the Members of this Commission know, machine tools are a leading indicator of manufacturing activity. So it is logical that the trends that I have just recounted were mirrored in the activity of overall U.S. manufacturing, with its loss of millions of jobs and a foreign manufacturing penetration increase of approximately 12 percentage points over a similar period (from 40 percent in 1998 to approximately 52 percent in 2002). That fact should be equally troubling to Members of this Commission.

There are many critical challenges for the United States defense industrial base. First and foremost is the decreased size of the industrial sector. The Asian currency crisis of 1998 was the first blow. This was followed by a five-year period when the euro was 20 to 30 percent below its historic levels (for a similar basket of currencies). Foreign demand for U.S. machine tools was drawn away by the attractiveness of products priced in the weak euro and an aggressively cost-competitive Asian competitors, also armed with an under-priced currency.

Add to the above problems the fact that, second only to Japan, United States industry is among the highest taxed among industrialized countries. Indeed, a recent study issued jointly by the Manufacturers Alliance ("MAPI") and the National Association of Manufacturers ("NAM") found that U.S. industry operates under a 22 percent cost disadvantage as a result of its tax and regulatory burden **(Item 7)**.

The largest and fastest growing machine tool market in the world is found in China, and U.S. machine tool builders are eager to compete for business there. Yet many barriers stand in their way. Let me briefly summarize those barriers.

First and foremost, export controls limit U.S. machine tool trade with China, particularly those affecting 5-axis machining, have negatively impacted the U.S. machine tool industry. The United States has had a strict regime of export controls since the end of the Second World War. With its one country veto system, CoCom limited all Western industrialized countries alike from trading with China (among others). But after 1994, when enforcement of the multilateral rules affecting export controls became a matter of "national discretion," U.S. vendors experienced a license denial rate from the U.S. Government of more than 50 percent, while their European counterparts saw their licenses for the same or similar products approved quickly and positively. As a result, the Chinese were denied almost none of the multiple-axis, precision machine tools that they desired, but U.S. vendors found themselves increasingly excluded from a lucrative market, which eventually became the largest machine tool market in the world. Not only did the license denials for controlled products hurt sales but those denials caused U.S. machine tool builders to develop a reputation for unreliability that carried over to lower technology, non-export controlled products as well.

In recent years, the Chinese have developed five-axis machine tools, which, after all, is a technology that is more than 40 years old. But they still depend on Western technology for most of their sophisticated applications, realizing that they are still unable to develop the precision and reliability needed for many advanced manufacturing applications. Right now they are able to produce large volumes of unsophisticated machines, but the expectation is that within five years the Chinese will be ready to compete in world markets.

Another problem which has plagued the machine tool industry's competitiveness in China has been the difficulty in obtaining business visas for prospective customers to visit plants to witness demonstrations of products, to attend trade shows, or to come the United States to witness machine tool run-offs and demonstrations that a machine is working well and ready to be shipped to the customer for his production line. Within a few months of 9/11, the business visa process changed dramatically. Business visas which used to take a few weeks, began to take several months, if they could be obtained at all. We began to hear continuing reports from AMT member companies of long delays in processing applications for visas for business-related travel to the United States. There seemed to be a consistent pattern of four-month delays in visa processing for business travel. In some consular posts, this delay is exacerbated by additional delays in obtaining interviews to submit visa applications. Further, AMT reported increased denials of visa applications for their overseas customers (without explanation).

Part of the delay appeared to be related to new security procedures for reviewing visa applications for counter-terrorism purposes, but a far larger portion of the problem appeared to be related to reviewing visa applications for technology control pur-

poses. These review procedures are not related to counter-terrorism or other border security reasons. The U.S. technology control procedures for visa application reviews were suddenly changed in late July 2002 and applied to all visa applicants. The impact is especially severe for business travel to the U.S. for China (and a number of other Asian countries).

I know that the long delays and increased denials for technology-control purposes caused substantial competitiveness problems for a number of U.S. industry sectors, but it was particularly acute for the machine tool industry. The inability to secure U.S. visas for overseas customers on a timely basis directly contributed to loss of sales, shifts of sourcing to foreign competitors, and reduced business opportunities for AMT member companies. Indeed, in company after company that I visited during a recent trip to China, the difficulty in obtaining a business visa was cited by managers as a potential reason for not buying our members' products.

I know that this year has seen a significant improvement in the business visa processing times, with increased personnel assigned to the task and new procedures, and that Secretary Rice has committed herself to continuing to improve the situation, but I cannot emphasize enough the deleterious effect that these business visa delays and denials have had on our U.S. machine tool competitiveness in what has become the largest market in the world.

Finally, I would like to discuss the most significant competitiveness problem of all and the one that has the greatest indirect effect on the U.S. defense industrial base. I am referring to the problem of currency valuation.

Last year, our nation's bilateral trade deficit with China exceeded $162 billion, the largest bilateral trade deficit in the world. Based on the first four months of 2005, that deficit is headed for almost $200 billion this year. It is a deficit and a trend that any economist will tell you is unsustainable. Yet it has continued to grow at this pace for the past decade. Indeed, China is accumulating foreign currency reserves, mostly U.S. dollars, at a rate of more than $6 billion per month. This is an uneven trading arrangement, and it is directly related to a distortion in the value of the two nations' currencies.

It is obvious that China's economic strategy over the past decade has been to keep the value of its currency low, boosting its exports and holding down imports. While many have observed that this is a highly successful strategy, another way of looking at it is that this is a shrewd method of exporting unemployment. Chinese intervention, through massive purchases of U.S. dollars, has kept the Chinese yuan from appreciating despite large trade surpluses and investment inflows. Ernest H. Preeg, of the Manufacturers Alliance and the Hudson Institute, has estimated that the yuan is as much as 40 percent below the value that would be set by the marketplace. Other international economists have estimated as much as a 50 percent under-valuation. By Preeg's calculation, that undervaluation means that U.S. exports to China would be overpriced by as much as 40 percent and that Chinese goods in the U.S. would be under priced by that much. This is a critical factor in the huge U.S. trade deficit with China and in the relocation of so many U.S. manufacturing enterprises, both large and small, to China, where those same companies can benefit from what is, in effect, a tremendous subsidy. When this subsidy is added to the very substantial differential in labor costs between our two nations, this subsidy makes Chinese products almost irresistible and makes investment in Chinese manufacturing extremely attractive.

It is indisputable that there is no free market for the yuan. Despite rapid economic growth, rapidly rising productivity, soaring exports, and huge foreign investment inflows—all factors that would normally cause a currency to appreciate—China has kept its currency pegged at approximately 8.25 yuan to the dollar since 1994. The Chinese central bank sets the exchange rate by requiring companies and individuals to turn over their foreign currency earnings at the rate set by the bank. As noted, the central bank, in turn, has made massive purchases of U.S. dollars, adding these to China's foreign currency reserve accounts. China's foreign currency reserves, almost entirely in dollars, now stand at more than $500 billion. Those dollar holdings have tripled in five years, and the pace of accumulation has been increasing over the past year.

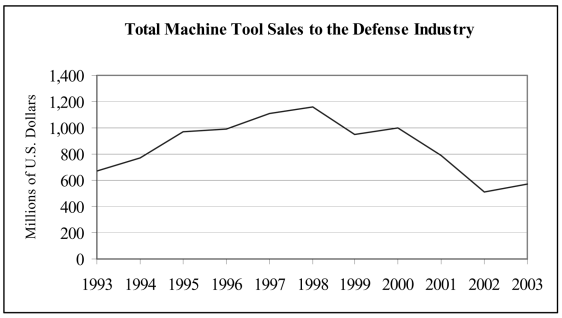
Let me repeat it again, the U.S. trade deficit with China was $162 billion last year, the largest bilateral trade deficit in the world! And for those who will tell you that China trade is self-correcting, I would point out that United States imports from China have been growing at more than twice the rate of U.S. exports to China. Underlying all this is the currency imbalance. China's import tariffs currently average about 15 percent. If Preeg and his colleagues are correct and the currency is 40 percent undervalued, the effect of a free and open currency market would be more than twice as large as the effect of eliminating every tariff that China imposes on our goods.

The global U.S. trade deficit last year was $600 billion—up $400 billion in the last five years and now nearly five percent of the United States' GDP. The major reason for the deficit during those five years is that the U.S. dollar has been significantly overvalued relative to foreign currencies. The dollar peaked in February 2002 at 30 percent above its normal level for the previous decade. Since then it has been returning to more normal levels against non-Asian currencies. Most of the adjustment has been against the euro. None could occur against the yuan, because it is pegged to the dollar at the artificial rate of 8.25 to one.

I began this testimony by answering the question of what is wrong with the U.S. machine tool industry with the reply that what is wrong is that many of their customers have closed shop, or moved to China. I think that I have given the major reasons why those events have taken place. But if one asks what can be done about that disturbing trend my answer would have to begin with the importance of dealing with the dollar-yuan valuation issue. Whether it is through Chinese central bank unilaterally re-pegging of the yuan, or through some form of a controlled float, the yuan must be revalued upwards. The Chinese government legitimately worries that revaluation could very likely affect their banking system adversely. Nevertheless, postponing the inevitable appreciation of the yuan can only make Chinese banks even less stable when the event finally takes place, as it inevitably must. The current relationship of our two currencies is untenable, and the sooner steps are taken to rectify the situation, the better. The Chinese government has acknowledged that there is a problem, but it is now asking for time to deal with the problem. We have been hearing this refrain for the past few years, and, as John Maynard Keynes observed, "In the long run, we shall all be dead." I fear that that is what is going to happen to many U.S. companies and the defense industrial base of which they are a part if we continue to delay and temporize on the currency issue.

Appendices: Items 1 through 7

Item 1: Machine Tool Sales to the Defense Industry



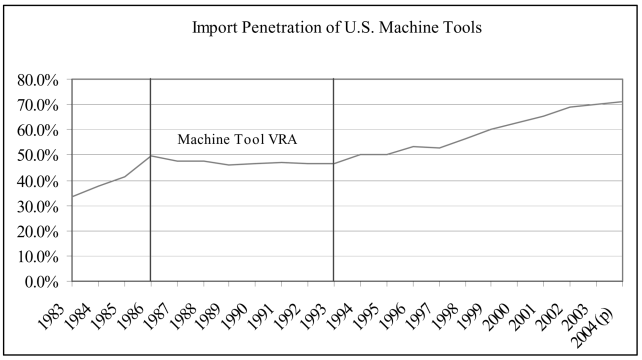
Machine Tool Sales to the Defense Industry

In Millions of U.S. Dollars

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Direct Sales	$60.4	$36.5	$29.9	$21.1	$38.1	$37.6	$35.8	$49.0	$54.5	$44.8	$66.9
Indirect Sales Estimate	609.2	732.3	940.4	969.4	1,074.9	1,119.3	913.3	948.6	732.3	469.7	499.0
Total Sales	669.6	768.8	970.3	990.5	1,113.0	1,156.9	949.1	997.6	786.8	514.5	565.9

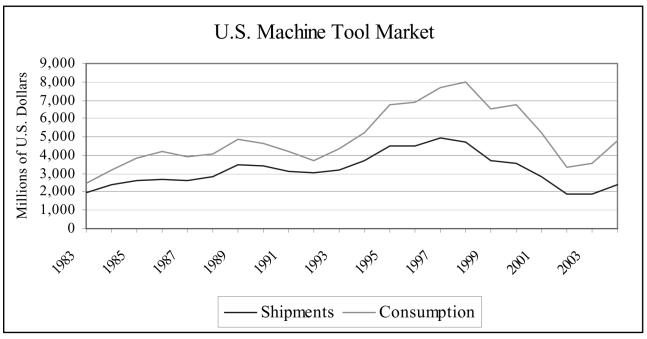
Source: Department of Defense, OASD, "Military Prime Contract Awards, by Service Category and Federal Supply Classification," and AMT.

Item 2: Import Penetration of the U.S. Market



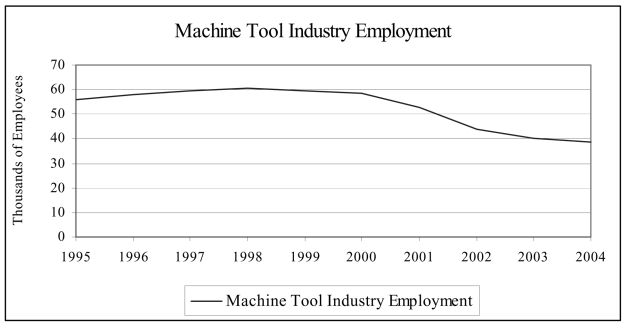
Source: U.S. Department of Commerce

Item 3: The U.S. Machine Tool Market



Source: U.S. Department Of Commerce

Item 4: The U.S. Machine Tool Employment



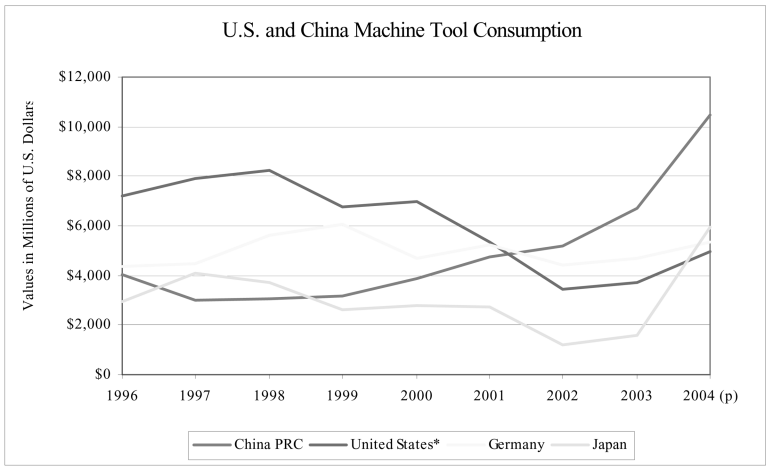
U.S. Machine Tool Employment Statistics

In Thousands of Employees

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Machine Tool Industry Employment	56.1	58.2	59.4	60.6	59.8	58.3	52.9	43.7	40.4	38.9

Source: Bureau of Labor Statistics

Item 5: World Machine Tool Market Consumers



Source: U.S. Department of Commerce, AMT, *Metalworking Insiders' Report* and other international machine tool associations

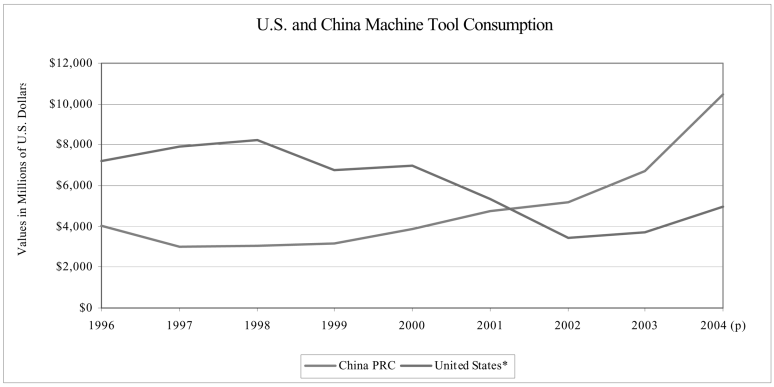
In Millions of U.S. Dollars

	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004 (p)**
China PRC	$4,010.4	$3,003.1	$3,048.7	$3,144.1	$3,850.3	$4,738.9	$5,187.0	$6,731.8	$10,475.6
United States*	7,187.1	7,916.5	8,209.5	6,743.1	6,971.0	5,347.9	3,463.2	3,684.6	4,965.2
Germany	4,351.7	4,482.4	5,602.4	6,054.4	4,665.5	5,237.4	4,438.5	4,671.6	5,353.4
Japan	2,963.7	4,067.3	3,695.6	2,637.9	2,794.3	2,729.8	1,214.6	1,600.5	5,923.8

Source: U.S. Department of Commerce, AMT, *Metalworking Insiders' Report* and other international machine tool associations
Notes: (p) – Preliminary

Laser data, from GTIS and other sources were added to US machine tool data (1996-2003) to create consumption figures that are comparable to other countries, which include lasers in their machine tool data.

Item 6: Machine Tool Consumption in China and the United States



Source: U.S. Department of Commerce, AMT, Chinese Machine Tool Builders Association

Machine Tool Consumption in the United States and China

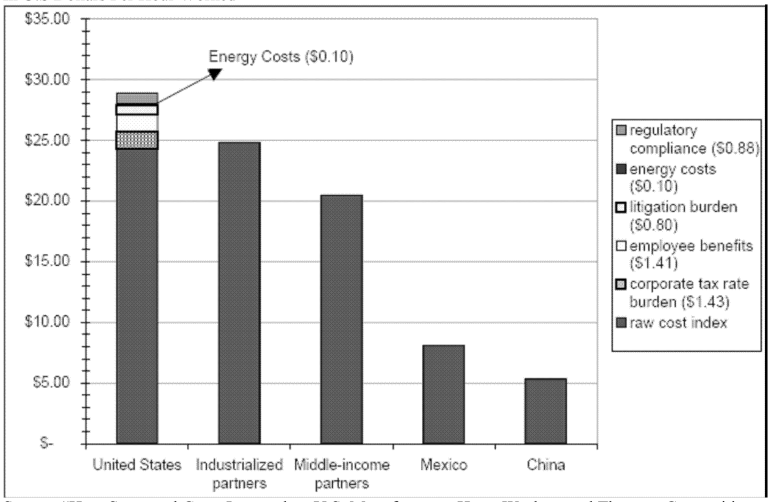
	1996	1997	1998	1999	2000	2001	2002	2003	2004 (p)
China PRC	$4,010.4	$3,003.1	$3,048.7	$3,144.1	$3,850.3	$4,738.9	$5,187.0	$6,731.8	$10,475.6
United States*	7,187.1	7,916.5	8,209.5	6,743.1	6,971.0	5,347.9	3,463.2	3,684.6	4,965.2

Source: U.S. Department of Commerce, AMT, Chinese Machine Tool Builders Association
Notes: (p) – Preliminary

Laser data, from GTIS and other sources were added to US machine tool data (1996-2003) to create consumption figures that are comparable to other countries, which include lasers in their machine tool data.

Item 7: Excess Burden of "Overhead Costs" on U.S. Manufacturers Relative to Major Trade Partners, 2002

In U.S Dollars Per Hour Worked



Source: "How Structural Costs Imposed on U.S. Manufacturers Harm Workers and Threaten Competitiveness," National Association of Manufacturers and Manufacturers Alliance (MAPI).

Source: U.S. Department of Commerce

Cochair WESSEL. Thank you. Dr. Shilling.

STATEMENT OF JACK W. SHILLING
CHAIRMAN, SPECIALTY STEEL INDUSTRY OF NORTH AMERICA
EXECUTIVE VICE PRESIDENT
CORPORATE DEVELOPMENT AND CHIEF TECHNICAL OFFICER
ALLEGHENY TECHNOLOGIES, INCORPORATED, PITTSBURGH, PA

Dr. SHILLING. I'm Jack Shilling, Chairman of SSINA, the Specialty Steel Industry of North America, and I'm also Executive Vice President, Corporate Development and Chief Technical Officer of Allegheny Technologies Incorporated.

Thank you very, very much for inviting me to appear before you today on behalf of SSINA, which is a trade group, comprised of 16 companies engaged in the manufacture and distribution of specialty metals. These materials include stainless steel, super alloys and other nickel alloys, titanium and titanium alloys, zirconium, and niobium alloys among others.

Our business is not conventional steel. Our products are crucial to national defense. Simply put, weapons systems can neither be built nor operated without these materials, whether it's missiles, jet aircraft, subs, helicopters, Humvees or munitions. American-made specialty metals are crucial components of U.S. military strength.

These specialty metal products are very high tech in nature and are in a continuing state of technology development. They are not

"off-the-shelf items" and are often proprietary and sole-sourced by U.S. manufacturers.

In other cases, alternate sources of supply exist in foreign countries where dependable suppliers may come and go based on how their governments react to then current U.S. military policies.

Attached to my testimony is a paper describing the importance of the U.S. specialty metal industry to the national defense, the challenges facing this industry, and the U.S. industrial economy, and public policies to support the long-term survival of the industry.

In addition, we are preparing a new report describing the specific materials we supply for national defense requirements. In summary, this report will make the following five points:

First, members of SSINA produce leading edge and high tech specialty metals critical to the national defense and are world class from a performance and cost standpoint.

Secondly, leading edge defense applications represent less than ten percent of overall sales of these specialty metals companies. Yet, these same defense applications are processed over the same equipment and developed by the same engineers that support the other businesses of these companies. Thus, the overall financial health of these companies is of utmost importance to the defense related industrial base of the country.

Third, the United States could lose its specialty metals industry over time if the industry decreased domestic investment in manufacturing capability and technology and instead chooses to move these activities offshore.

Fourth, in order to help assure the long-term survival of our industry, actions must be taken to encourage ongoing investment in U.S. specialty metals manufacturing and in the development of technology consistent with a non-protectionist, fair trade, level playing field agenda. These actions must address the following issues: enforcement and strengthening of U.S. trade laws; support of the specialty metals provision of the Berry Amendment; and currently non-competitive energy, regulatory, tax and post-retirement benefit costs; and finally education.

The last point we raise is that the defense industrial base, and it's a very important one, the Defense Industrial Base Capabilities studies and DoD's annual reports produced to Congress fail to examine much of the U.S. industrial base.

Turning now to China, the Commission has posed three questions. First, has the industry's relationship with the DoD changed? Quite simply it has changed dramatically in two primary ways:

DoD policymakers no longer seem to evaluate, understand and appreciate the critical role that specialty metals play in national defense. Reports issued by the Defense Department on the defense industrial base fail to even mention the specialty metal sector, let alone reflect an understanding of its importance.

Secondly, DoD now has a shortsighted, non-strategic focus on lower costs, often obtained by sourcing abroad. This has been reflected in lax enforcement of the Berry Amendment, as Congress has noted repeatedly.

Over the last decade, and this was discussed earlier today, over the last decade, member companies of SSINA have conducted sig-

nificant research and development in support of their non-defense business, for example, commercial aerospace.

This has a beneficial effect on defense capability, but such R&D is totally dependent on the financial health of our core businesses.

Second question: how has the U.S.-China trade specifically and globalization generally changed the specialty metals portion of the industrial base?

Interesting question. So far, not much, thankfully. China is currently incapable of making most if not all specialty metals required for leading edge defense applications. However, China is aggressively seeking Western technology and offering up access to its market in return for that technology. China's approach is a systematic, highly coordinated, strategic initiative in my opinion, which left unchallenged, will eventually result in the transfer of significant specialty metals technology and manufacturing capability to China. DoD procurement policies may actually accelerate and encourage the process.

How can these trends be reversed and the problems averted? Dramatic, comprehensive and swift action is required in two areas:

First, the U.S. needs to create an industrial policy that encourages investment in U.S. manufacturing, particularly as it relates to specialty metals.

Secondly, the Defense Department must be held accountable to accurately report on the critical importance of specialty metals to national defense and purchase their requirements from U.S. manufacturers.

The third question posed by the Commission—how have China's investment and acquisition strategies in specialty metals affected U.S. defense capability? Fortunately, not much to date, but again the handwriting is on the wall. There are numerous documented examples of Chinese efforts to lock up critical raw materials such as nickel, either through outright acquisition of Western companies such as Noranda or by entering into long-term supply agreements with nickel producers such as INCO, or by acquiring critical nuclear reactor technologies, including zirconium-related technologies by trading access to their market for such technologies.

I have experienced some of these attempts first hand. ATI's technological expertise is world-renowned. In addition, ATI operates a joint venture in China focused on the manufacture of precision rolled stainless steel strip for commercial applications, primarily in the electronics industry.

ATI has been approached on numerous occasions by a number of Chinese state-owned enterprises asking us to partner with them in these high-tech specialty materials. In all cases, the concept was access to the Chinese market in return for ATI critical proprietary technology.

It is important to understand—this is so important—that there is not a sharp line that separates critical defense related technologies from important processing technology related to the manufacture of these same specialty metals for non-defense applications. Transferring basic technologies to China would greatly facilitate Chinese mastery of more leading edge technologies.

It's also very important to understand that technology development travels with the manufacturing process. Our plants in the

specialty metals industry are our laboratories. It's thus naive to think that manufacturing of these materials could be transferred to China while technology development is kept here in the United States.

Thank you.

[The statement follows:]

Prepared Statement of Jack W. Shilling
Chairman, Specialty Steel Industry of North America
Executive Vice President
Corporate Development and Chief Technical Officer
Allegheny Technologies, Incorporated, Pittsburgh, PA

Members of the U.S.-China Commission:

I am Jack W. Shilling, Chairman of SSINA, the Specialty Steel Industry of North America and Executive Vice President, Corporate Development and Chief Technical Officer, of Allegheny Technologies Incorporated.

Thank you for inviting me to appear before you today on behalf of the Specialty Steel Industry of North America, a trade group comprised of sixteen companies engaged in the manufacture and distribution of specialty metals. The "specialty" nature of these materials refers to their unique chemistry and high-tech processing requirements. These materials include stainless steels, superalloys and other nickel alloys, titanium and titanium alloys, zirconium, and niobium alloys among others. *The focus of our businesses is not conventional "steel."*

Use of our products is important to a wide variety of industrial markets. Furthermore, our products are crucial to national defense.

Specialty metals are vitally important to virtually every U.S. military platform. Simply put, weapons systems can neither be built nor operated without these materials. Whether it is missiles, jet aircraft, submarines, helicopters, Humvees or munitions, American-made specialty metals are crucial components of U.S. military strength, whether we are at peace or at war.

These specialty metal products are very high-tech in nature and are in a continuing state of technology development. They are not "off the shelf items." It is their superior performance, often under severe operating conditions, that enable U.S. defense systems to function at high levels of performance and to do so reliably.

Because of the critical nature and advanced technology in these materials, and because so many of them have been invented and developed by the domestic specialty metals industry, many of these materials are proprietary and "sole-sourced," meaning that they are supplied by only one manufacturer in the world, and those manufacturers are in the United States. In other cases, alternate sources of supply exist in foreign countries where dependable suppliers may come and go based on how their governments react to then-current U.S. military policies.

U.S. military capabilities are directly dependent upon the availability of crucial specialty metals. Without them, the U.S. military would not have the ability to fight a war. Without them, the U.S. military and homeland security forces would be unable to defend our borders and protect our citizens from terrorism.

Attached to my testimony is a paper we originally issued July 2004 and updated in February of this year. This paper describes our view of the importance of the U.S. specialty metals industry to the national defense, the challenges facing this industry and the U.S. industrial economy, and suggests public policies to support the long-term survival of the industry.

We are preparing a report describing the materials we supply for national defense requirements. In summary, our report will state the following:

- Members of SSINA produce leading edge and high-technology specialty metals critical to the national defense and are world class from both a performance and cost standpoint.
- Leading edge defense applications represent less than 10% of overall sales of these specialty metals companies, yet these defense-related products are processed over the same equipment and developed by the same engineers that support other businesses of these companies. The overall financial health of SSINA member companies is of utmost importance to the defense related industrial base of the country. The profits from these other business segments of the specialty metals companies support and sustain the manufacture and development of specialty metal products for critical U.S. defense applications.
- The United States could lose its specialty metals industry, over time, if the industry decreases domestic investment in manufacturing capability and tech-

nology and instead chooses to move these activities offshore to improve the profitability of its core businesses, facilitated by disincentives to invest here vs. overseas. Although our industry may be profitable currently and is acknowledged to be the global leader in technology and low cost manufacturing in many areas, the playing field is becoming increasingly tilted in favor of moving production and technology offshore. The negative implications for U.S. national defense are obvious.

- In order to help assure the long term survival of our industry, actions must be taken to encourage ongoing investment in U.S. specialty metals manufacturing and in the development of technology consistent with a non-protectionist, fair trade, level playing field agenda. These actions must address the following issues: enforcement and strengthening of U.S. trade laws; support of the Berry amendment, specialty metals provision; currently non-competitive energy, regulatory, tax, and post retirement benefit costs; and education.
- The Defense Industrial Base Capabilities studies produced by DoD fail to examine much of the U.S. industrial base.
- The reports submitted by the Department of Defense to Congress do not comply with the statutory requirement that DoD provide Congress with an annual report on the U.S. "industrial base" and its capability to support national defense requirements, particularly with regard to the role of specialty metals.

China's Threat

Turning now to China, the Commission has posed three questions. Let me attempt to address each one in the time remaining.

Has the industry's relationship with DoD changed? Quite simply, it has changed dramatically in two primary ways:

First of all, the DoD, particularly the Industrial Policy and Acquisition Directorates, no longer seem to evaluate, understand and appreciate the critical role that specialty metals play in national defense. Many of the reports issued by DoD on the Defense Industrial Base fail to even mention the specialty metals sector, let alone reflect an understanding of its importance.

Secondly, previous understanding and appreciation of this issue has been replaced by what appears to be a short sighted, non-strategic search for lower costs, often obtained by sourcing more commodity oriented specialty metal products from foreign sources.

This has been reflected in lax enforcement or blanket waivers of the Specialty Metals provision of the Berry amendment, which mandates the use of U.S.-melted specialty metals in defense procurement, particularly weapons systems and aerospace. Congress has highlighted this issue repeatedly over the past two years.

Over the last decade, the member companies of SSINA conduct significant R&D in support of their non-defense business, for example, commercial aerospace. This has had a beneficial effect on defense capability. But the ongoing ability to conduct such R&D, as mentioned earlier, is dependent on the financial health of the core businesses of the companies.

Some DoD sponsored R&D has been conducted as well, but it is our impression that funding for these activities has been and continues to be under significant budgetary pressure, exhibiting a lack of appreciation of the importance of our industry to national defense.

While this disregard for the importance and health of the specialty metals industry may not yet have materially damaged our industry's R&D to date, the handwriting is on the wall. As noted above, if the DoD does not stand up and support the specialty metals industry as being critical to national defense, and if the U.S. Government does not create a climate that encourages investment in our industry, there is a very good chance that, over time, this industry could move offshore, both from a manufacturing as well as R&D standpoint. That time is drawing nearer. Remember, defense applications account for less than 10% of revenues in these companies, thus the overall health of this industry is of critical importance to national defense. Our industry only seeks a level playing field on which to compete. It does not need protection. However, the field is not level currently, and to make matters worse, instead of standing up and supporting our industry, some representative of the DoD openly suggest that our industry is not important to the country's defense capabilities. Over the last 10 years, we have witnessed a frightening trend that could result in the gradual dissolution of the domestic specialty metals defense capability.

How has U.S.-China trade changed the specialty metals portion of the industrial base? So far, not much, thankfully.

China is currently incapable of making most if not all specialty metals required for leading edge defense applications. However, China is aggressively seeking West-

ern technology and offering up access to its market in return for technology. Many U.S. companies appear to be willing to accommodate the Chinese. These companies are not in the field of leading edge specialty metals fortunately, but that could change in the future. China's approach is a systematic, highly coordinated, strategic initiative in my opinion, which left unchallenged will eventually result in the transfer of significant technology and manufacturing capability to China. China's infrastructure in this area is being completely rebuilt with state-of-the-art equipment, which will result in an increase in its global position in the specialty metals sector. However, to date, critical manufacturing process technology that would be necessary for most important defense applications has not been transferred to the Chinese to the best of my knowledge. On the other hand, in the commodity stainless steel arena, a combination of foreign investment, significant transfer of Western process technology, and government subsidization have resulted in a dramatic growth in capability. In a period of less than three years, China has become a major exporter of stainless steel flat-rolled products—a core commodity product at my company, ATI. China is now the number two offshore source of stainless flat-rolled products in the U.S. market, having increased its exports to the U.S. by over 500% over the past year.

It is clear that current DoD procurement policies may actually accelerate and encourage this process. In fact, the current foreign direct investment policies of Western companies in areas other than specialty metals are facilitating the transfer of technology and manufacturing to China. If and when this happens in specialty metals, it will result in the gradual loss of U.S. defense capability, and we will have facilitated our own demise. Apart from trade-related issues, China's growth, per se, has clearly fueled the unparalleled run-up in prices of all raw materials, which has resulted in significant increases in the price of many specialty metals that use these raw materials.

How can these trends be reversed and problems averted? Dramatic, comprehensive and swift action is required in two areas:

1. First, the U.S. needs to create an industrial policy that encourages investment in U.S. manufacturing, particularly as it relates to specialty metals. Specific issues were mentioned previously and are detailed in our reports.
2. Secondly, the DoD must be held accountable to accurately report on the critical importance of specialty metals to national defense and purchase their requirements from U.S. manufacturers.

How have China's investment and acquisition strategies in specialty metals affected U.S. defense capability? Fortunately, not much to date, but again the handwriting is on the wall.

There is no doubt the Chinese government is aggressively pursuing this capability, but so far, they have been unsuccessful. There are numerous examples of such attempts that have been chronicled in the newspapers including efforts to lock up critical raw materials such as nickel either through outright acquisition (Noranda/Falconbridge) or supply agreements (INCO) or acquire critical nuclear reactor technologies, including zirconium-related technologies by trading access to their markets for such technologies.

I have experienced some of these attempts first hand. ATI's technological expertise in the area of specialty metals is world renowned. In addition, ATI operates a joint venture in China focussed on the manufacture of precision rolled stainless steel strip for commercial applications, primarily in the electronics industry. As a result of these two factors, ATI has been approached on numerous occasions by a number of Chinese state owned enterprises asking us to partner with them in these high-tech specialty materials. In all cases, the concept was access to the Chinese market in return for access to ATI critical proprietary technology.

In this context, it is important to understand that there is not a sharp line that separates critical defense related technologies from important processing technology related to the manufacture of these same specialty metals for non-defense applications. It has taken our industry decades to develop the basic processes required to make high quality specialty metals for demanding non-defense related applications, e.g. commercial aerospace. Therefore, there are numerous, basic technologies that while being U.S. export-compliant, are nonetheless critical to development of leading edge defense applications. Transferring basic technologies to China would greatly facilitate Chinese mastery of more leading edge technologies.

It is very important to understand that technology development travels with the manufacturing process. Our plants in the specialty metals industry are our laboratories. It is thus naïve to think that manufacturing of these materials could be transferred to China while technology development is kept here in the U.S.

Thank you for the opportunity to address the Commission. I will be happy to answer any questions you may have.

Panel IV: Discussion, Questions and Answers

Cochair WESSEL. Thank you and your statements will all be made part of the record and we appreciate your being here. Commissioner Becker.

Commissioner BECKER. Thank you, Mr. Chairman. I have a question for Mr. Chao.

Mr. CHAO. Chao.

Commissioner BECKER. Chao. You talked about offsets, and we've heard an awful lot about them. We've had testimony here before this Commission by representatives of the employees of Boeing and others who have indicated that they were coerced to provide offsets in order for Boeing to have access to the Chinese market in some form or another.

But setting that aside, we do recognize that offsets have taken place. Do those offsets require an export license?

Mr. CHAO. It depends on how the offset is met, because they can either be met with indirect offsets, i.e., things outside the aerospace/defense industry which would not require an export license of any form. It would be reported to the Commerce Department as an offset however. To the extent that it was related to a military related technology, that would require an export license.

Commissioner BECKER. Not simply a transfer of technology?

Mr. CHAO. A transfer of technology again related to military would require an export license, so there would be visibility into that.

Commissioner BECKER. Are those easily separated, military or commercial?

Mr. CHAO. On some of the dual-use side, no, not easily.

Commissioner BECKER. Thank you. I have a question for Mr. Shilling.

Dr. SHILLING. Yes, sir.

Commissioner BECKER. You mentioned that Allegheny Technologies has built a state-of-the-art stainless plant, if I might add.

Dr. SHILLING. Yes.

Commissioner BECKER. Quite a few years ago.

Dr. SHILLING. Right. That's right.

Commissioner BECKER. When that happened, there was a lot of discussion. Was there any transfer of technology on that?

Dr. SHILLING. Absolutely, yes. No question. I go to China five times a year basically. In fact, I brought my Chinese business cards with me for effect. The Chinese have virtually no metals technology.

Commissioner BECKER. Right.

Dr. SHILLING. Except for what they have purchased from Western companies, and they're purchasing it at a rapid rate, and whoever will sell it to them, they'll buy it. So in our case, we transferred willingly process technology related to manufacturing precision rolled stainless steel strip for the electronics industry.

It has limited implications for defense applications. None, I'll say. But, yes, we transferred that technology and the joint venture has been very successful.

Commissioner BECKER. The company I understand is planning to expand into other activities in China?

Dr. SHILLING. We've discussed publicly that we're at capacity and that we're profitable and we're looking at what the next step should be in order to keep growing with the electronics market primarily in China.

Commissioner BECKER. Do you export any of the product back into the United States?

Dr. SHILLING. We do not.

Commissioner BECKER. If you increase your capacity, if you hit a point where the capacity is in excess of what you're selling in China, would you plan on exporting that back into the United States?

Dr. SHILLING. We would not.

Commissioner BECKER. You would not.

Dr. SHILLING. We're speaking for ATI here. And as was mentioned earlier by one of the Commissioners, the free enterprise system puts those decisions squarely on the shoulders of the CEOs of the companies, and their first priority is to their shareholders. That's the way the system works, and it was mentioned earlier the Chinese government has figured this whole thing out.

But in our case, we would want to expand at the rate that the Chinese market is expanding. We would not be building this asset in China were we to expand with the thought of exporting back into the United States. That wouldn't be why we would be doing it.

Commissioner BECKER. Well, if you permit just an observation here. It seems to me that you're wanting it both ways. You're wanting the United States to assure a safe market here in this country and at the same time you're taking resources and technology and moving it to China in order to build it over there.

Dr. SHILLING. Yes. I think one has to be quite careful about which technologies we move. We have not moved any defense-related, aerospace-related technologies, despite the fact that we've been asked many times to do so.

Commissioner BECKER. Just a question I think would hit on technology. How thin can you roll that stainless in China?

Dr. SHILLING. 50 microns.

Commissioner BECKER. All right. And is that not defense-related?

Dr. SHILLING. No, not per se.

Commissioner BECKER. Not per se.

Dr. SHILLING. Not per se. I think it's an important distinction, and I'm glad you brought this up because our white papers and the statements that we've made as an industry, after—I've been doing this for two years, talking about this China problem. That's why I'm glad to be here.

It was stated here earlier, what is the solution? It's a tough issue, and I do not think that isolation is the answer personally. I think that we need to have multinational companies, we need to have companies like ATI and others, and by the way, almost every member of SSINA is a multinational company. These high-tech materials, the U.S. has the lead in this technology, over Europe, over Japan, over any other country in the world, the best specialty metals technology is in the United States.

So these, by definition, these companies are multinational. They export a lot, and I don't think the solution to this problem is isolationist. I really don't. I think we want to encourage investment in the United States.

If you ask the CEO of a specialty metals company where are you going to spend your next $100 million, he's got to decide where the return on investment is. And right now, there are a lot of disincentives to invest here in the United States. Just take one example: energy costs. It's absurd. This country has no energy policy that makes sense for heavy manufacturing investors like us.

To make matters worse, we operate plants all over the United States, and it's ridiculous, the difference in energy costs from state to state, which is brought about strictly by the very poor job of the way electricity was deregulated or not deregulated, as the case may be.

Commissioner BECKER. The more you invest in China, though, the more that you take the money and the technology and put into China puts at risk more of the technology and the plants that you have here in the United States.

Dr. SHILLING. Commissioner Becker, I agree with that, and therefore what ATI—I'm speaking for ATI—what ATI discusses everyday is what that balance should be, and I'm proud to say that ATI, we just made a major acquisition in the United States. We bought J&L and put those people back to work. And we just invested another 35 million in Brackenridge. We invested 200 million in Vandergriff. So ATI is one of those companies that looks at that balance and so far has invested most of its capital in the U.S.

But I'm telling you, I'm not predicting what ATI is going to do at all here. I'm worried about the company. I'm just saying that every year it gets tougher and tougher and tougher to put that 100 million in the U.S.

Commissioner BECKER. Thank you. My time is more than up.

Cochair WESSEL. We may have the opportunity to go back for a second round. Commissioner Wortzel.

Cochair WORTZEL. Thank you. I have a question for Dr. Shilling, if I might. You've laid out a very good case on the manufacturing of specialty metals and why we need to maintain the capability to do that here. I understand, for instance, an F–18 engine, fighter jet engine, I understand that we can't get the materials to manufacture that engine here in the United States without—and I see you nodding your head, Peter, so anybody else who wants to contribute—without going to Russia for those materials.

That's my question.

Dr. SHILLING. That's not true.

Cochair WORTZEL. Could you describe if there are areas in terms of raw material supply——

Dr. SHILLING. Ah, different.

Cochair WORTZEL. That's right. Raw material supply where the United States cannot manufacture necessary specialty metals without complete dependence on foreign sources we don't control, and how that affects our national security?

Dr. SHILLING. First of all, right now, the world is experiencing a shortage of critical raw materials such as titanium which is what

you're referring to, I believe, such as nickel. Nickel you can get, but it's very, very expensive. Cobalt, the same thing.

I'm not personally aware of any instances where the Defense Department is unable to procure titanium related parts, to your point, based on a lack of raw materials. Having said that, though, it's interesting to observe that again, over the last several years, the production of raw titanium metals, titanium sponge, as it's called, has decreased in the United States.

The Defense Logistics Agency has depleted the stockpile of titanium, so there is a shortage of titanium, but what's driving that shortage like the same factor that's driving the shortage of all commodities is the huge economic development in China. China has been a huge consumer of titanium, not for defense but for industrial applications, as they have been for nickel, for stainless steel, as they have been for oil, as was discussed earlier.

But I'm not aware specifically to your question of any current supply problem, but I think it's a great question. I think, could there be a supply problem? Yes. And that's what I'm concerned about. And not only the raw material manufacturing process is also part of the manufacturing process. Sponge manufacturing is part of the manufacturing process. It's a great strategic question.

Mr. CHAO. There are certain exotic materials like beryllium that are only found outside or primarily found outside the U.S., and so it's not currently a problem, as he points out. Could it become one if that original source has a problem? Yes. That leads to stockpiling types of strategies.

We saw a similar phenomenon in the 1990s during the telecom ramp-up when certain raw materials were getting sucked up by the cell phone industry and the aerospace engine manufacturers were having a very difficult time getting their hands on them.

That's a different problem—it's a crowding-out effect by other parts of the economy that are growing faster, where aerospace defense is a small percentage. In addition, the high quality standards sometimes makes it unattractive for people to focus on the aerospace/defense sector when they can supply that much easier to the rest of the economy.

Cochair WORTZEL. But if we're talking about the long-term potential requirement to surge, then these are critical factors?

Mr. CHAO. Something to watch.

Dr. SHILLING. Yes, sir.

Cochair WESSEL. Commissioner Bryen.

Commissioner BRYEN. Thank you, Mr. Chairman. First of all, I want to welcome all three panelists, particularly Paul Freedenberg, who was a great Under Secretary of Commerce and is a great patriot. I had the privilege to serve with him in the DoD during the time he was at Commerce Department and always enjoyed fighting with him, but he is a formidable adversary and a grand friend.

Dr. FREEDENBERG. Thank you.

Commissioner BRYEN. So I welcome Paul.

Dr. FREEDENBERG. Thank you.

Commissioner BRYEN. I have questions for each of the panelists. If you don't mind, we'll start with Dr. Freedenberg and the U.S. machine tool industry. What, in your association, which represents I assume most of the U.S. manufacturers——

Dr. FREEDENBERG. Yes. Most.

Commissioner BRYEN. How many of those are non-U.S. owned today?

Dr. FREEDENBERG. I can't give you a percentage right now. I could supply it for the record, but I would say probably in our association, probably a fifth.

Commissioner BRYEN. About 20 percent. And most of those are European or Japanese?

Dr. FREEDENBERG. Both European and Japanese. They are considered part of the U.S. defense industrial base since they're domiciled in the U.S.

Commissioner BRYEN. So there's been at least some growth in foreign ownership in the industry?

Dr. FREEDENBERG. Yes.

Commissioner BRYEN. A kind of globalization, in a sense. Are U.S. companies also going abroad to set up factories?

Dr. FREEDENBERG. Yes, they are. It's become a world industry.

Commissioner BRYEN. I always thought that one of the arguments for the defense industry was being able to have access to specialized machine tools that were specially designed for the exotic, whether it's a spacecraft——

Dr. FREEDENBERG. Right.

Commissioner BRYEN. —or an aircraft like the JSF or whatever, that you need to keep that piece of the industrial base solid and intact for that reason. Do you accept that?

Dr. FREEDENBERG. Yes, I do.

Commissioner BRYEN. You can look at the industry globally, but I think it may not be as interesting as the more specific question: how do you make sure that U.S. defense industry has access to state-of-the-art machines that can help design the next generation of hardware that's needed both for space and for aerospace and other applications?

Dr. FREEDENBERG. If I could just make one point. Major new technologies, fiber placement that goes into the 787 and has gone into Stealth, and the two companies in the U.S. that make that have recently sold, in the last two years sold, and they both sold at fairly low market prices, which shows that there is not a great sense that this is a growth area, even though you have really the high end of U.S. technology on the block.

Commissioner BRYEN. It would be useful if you would supply the Commission with some background information. I think we would find that very useful.

Dr. FREEDENBERG. Yes, because it's an indicator of a decline.

Commissioner BRYEN. Exactly. This is for Dr. Chao. I found your comments very stimulating and interesting. Recently in the press there was an announcement by a serious French defense company that is entering into an agreement with Mikoyan, the Russian mig, to provide, let's say, technology cooperation, which I assume will end up in advancing the state-of-the-art of migs, both in the domestic Russian market, but also in the international market, and of course one of the big customers of that sort of thing is China.

Do you think that can pose a future problem and do you see that as a future problem for the U.S. and for the overall balance in the Pacific?

Mr. CHAO. From the perspective of at least making sure that the U.S. industry always maintains a technological lead, any time that there is a transferring of technology back and forth, it's something that you want to watch.

The one observation that I would make, and I think we saw that with the recent brouhaha over the lifting, the potential lifting of the EU embargo on China, was those companies who thought that they had an opportunity to enter into the U.S. marketplace were typically not the ones that were arguing for lifting the China embargo, ironically enough.

It was those firms that had given up hope of entering into the U.S. marketplace that were pushing the hardest. And the threat presented of, "well, if you do that, we won't let you into the U.S. market," their response back has been "you don't let us in anyway. So you have no stick over me!" This complicates the dilemma even more as we're contemplating this. But watching the movements among the peripheral players in the aerospace/defense industry is, I think, just as interesting or more important to monitor than what we're doing directly with China.

Commissioner BRYEN. Very good point. Mr. Chairman, could I have a couple more minutes? Dr. Shilling, Allegheny Metals or specialty metals, this was a company that the Japanese tried to acquire in around 1984; isn't that right?

Dr. SHILLING. Not to the best of my knowledge. I was there at the time.

Commissioner BRYEN. Were you?

Dr. SHILLING. Yes.

Commissioner BRYEN. Do you make powdered metals for——

Dr. SHILLING. No, we do not make powdered metals.

Commissioner BRYEN. You don't. Okay. So you're making what kind of materials?

Dr. SHILLING. Right now with the acquisition—we acquired Teledyne in 1996 and we picked up all their metals companies and then spun off the defense and the consumer products companies, and we're left with—we make flat roll products in virtually all of these alloys I mentioned. We make long products—billet, ingot, bar, wire, seamless tubing in all these different alloys from zirconium all the way through stainless.

Commissioner BRYEN. Zirconium has got a big nuclear application?

Dr. SHILLING. It does.

Commissioner BRYEN. Yes.

Dr. SHILLING. For sure.

Commissioner BRYEN. It's used as the cladding on the fuel rods.

Dr. SHILLING. It is. Correct.

Commissioner BRYEN. So it's very sensitive from a proliferation point of view?

Dr. SHILLING. Very sensitive, yes.

Commissioner BRYEN. I remember in Iraq they were getting these rods from Europe and some from Russia; that was a major problem.

Just a quick question: this self-restraint that your industry——

Dr. SHILLING. That's a good term.

Commissioner BRYEN. —is engaged in.

Dr. SHILLING. I wouldn't use the term "engaged." But that's what has happened.

Commissioner BRYEN. You were complaining about the Defense Department——

Dr. SHILLING. Yes.

Commissioner BRYEN. But do you communicate with the Defense Department about this? Do you try to arrive at some consensus?

Dr. SHILLING. I'll give you a quick snapshot of what happened. I became chairman of SSINA January of last year and took this statement to our member companies. They agreed with me, and our first step was to the Defense Department, so we have had a number of meetings with the Defense Department, and we continue to have them, and that was, I mentioned in my comments that we've prepared a special report that highlights exactly what we do for them, the industrial policy part of DoD.

They also had asked us to review their defense industrial base capability study reports, which we've done, and they don't reference specialty metals, and so that's where we are with them. We're still in discussions with them, and we intend to give them this document.

Commissioner BRYEN. Well, I think from the proliferation point of view alone, it's a pretty important area and a place for great concern, and the idea of relationship between the industry and the U.S. Government and especially the Defense Department is something that ought to be pursued. I hope the Commission will support that idea.

These companies are under tremendous industrial pressure. I think that's a fair way to put it.

Dr. SHILLING. There is no question.

Commissioner BRYEN. And these are difficult decisions to arrive at, particularly if you don't think you have the government behind you.

Dr. SHILLING. Well said.

Commissioner BRYEN. So I congratulate you on that effort, and I think it's really exemplary. Secondly, I hope the Commission will not only endorse it, but promote it as well, because it's a very good way to go. Thank you very much, Mr. Chairman. Thank you.

Cochair WESSEL. Thank you. Let me continue along the line that Commissioner Bryen was talking about, and regrettably as already has been noted by the morning co-chair, that DoD's lack of participation does not allow them to defend themselves in this, and we hope at some point they'll choose to participate.

Let me understand in terms of the operations you have in China, and a broader question that I hope the other panelists will talk about as well, which is the linkage between production and R&D in enhancing capabilities.

You indicated that where you're producing the metals is also the site of a lot of R&D because you want to be on the floor understanding process manufacturing, et cetera.

As we see the migration of some of these activities, whether it's machine tool production, whether it's aerospace, whether it's specialty metals, what implications does that have on our defense industrial base, our defense needs as well as Chinese capabilities?

I believe you said your facility there is a joint venture; is that correct?

Dr. SHILLING. It is.

Cochair WESSEL. I also assume, therefore, the Chinese have access to the technology?

Dr. SHILLING. No question.

Cochair WESSEL. Because they're a joint partner?

Dr. SHILLING. Absolutely.

Cochair WESSEL. Is that being applied by them in other operations in country? Does that enable them to enhance their capabilities because these products are so vital also to their defense needs?

Dr. SHILLING. The answer is essentially no because we selected this technology as being so unique to the electronics industry and the market is relatively small that it could be transferred by them; it's just that there is not a large incentive to do so. Because we're supplying with this joint venture a significant part of that market, and the technology is unique to those specific products.

Cochair WESSEL. Let me understand then. The product you're talking about is this chip fabrication?

Dr. SHILLING. No, it——

Cochair WESSEL. What is the product being used for specifically?

Dr. SHILLING. It's precision rolled stainless steel strip so if you have a cell phone, if you tore it apart and looked inside.

Cochair WESSEL. That connects the circuits?

Dr. SHILLING. It's not an electrical connection; it's a structural component of the cell phone. That's just an example.

Cochair WESSEL. Okay.

Dr. SHILLING. If you look in a hard drive inside a computer, there are little pieces of stainless steel in there that have certain temper properties that make that thing work, and so that's another example. Stamping is the general term.

Cochair WESSEL. Is the technology that you have there going down to fairly——

Dr. SHILLING. Right.

Cochair WESSEL. —precise tolerances, I guess, in terms of the rolling. Can that be applied in other applications that would enhance their capabilities there?

Dr. SHILLING. In defense related applications specifically? Theoretically, yes, but all this stuff is a gray area. There isn't a bright line between a defense application, a defense technology in our industry and a civil technology. But I think the risk is low compared to other technologies that we've been asked to transfer which we've refused to do so.

Cochair WESSEL. Okay.

Dr. SHILLING. Which I might add are export compliant. One of the things that people need to understand in our industry is that, and it's very supportive of what Dr. Schneider said earlier, most of the technologies, defense technologies, have been developed by the civil side of these businesses. And a lot of those technologies are viewed as generic, which they're not, in my opinion, but they could be sold to build, for example, a commercial jet engine.

But yet you can't separate the process technology that it takes us to make a nickel-based superalloy for a jet engine from the process technology that we will use to make a different nickel-based su-

peralloy for the F–135 Pratt-Whitney engine. They're close. So if you were to teach the Chinese how to make a commercial jet engine, you would move them decades ahead in their technological capability, and they couldn't immediately move to make a jet engine superalloy, but they're light-years closer.

Cochair WESSEL. As part of this, I assume that while the technology being transferred may not be controlled you're stepping them up the food chain, accelerating their development process in some areas. I'm not saying it's necessarily specialty metals. The R&D issue in general if you will, and getting them to the next stage of development that much faster.

Dr. SHILLING. Absolutely.

Cochair WESSEL. So an accelerant, if you will.

Dr. SHILLING. By orders of magnitude.

Cochair WESSEL. Okay. For the other panelists, the question of the breaking the linkage between production/R&D. Does R&D follow production? Does production follow R&D? What are its implications for us in terms of the defense industrial base?

Dr. FREEDENBERG. Our members have been approached for joint ventures in China. There are none right now. Most of them are unprofitable. It's much better to essentially set up your own operation, but the R&D does follow. And those who think that China is way behind—they are behind in machine tool technology that's for sure. But their companies are very well stocked with engineers and with modern cad cam and other sorts of things. So they can develop.

I went to one company in Shanghai that had two-thirds of its employees were engineers. They have an excess of engineers there, but two-thirds engineers. So this is not a low-tech country, and it's a country that can move along very rapidly. Again, if it were to get U.S. technologies, it could make use of them very effectively, and I think people tend to underestimate them.

I saw them move very quickly in a semiconductor area. You could see them move very quickly in a number of other areas as well.

Mr. CHAO. I think when you look broadly, scan across the industry, I think Dr. Shilling's example is repeated. It goes to my prior comment about self-restraint versus where there is a bright line that we put in place with our export control and technology transfer laws.

For the most part, I've seen industry, because of the fear of setting up a future potential competitor, staying relatively clear of that bright line, of not wanting to slice their own throat.

Now, the interesting part about the Chinese desire to pull in aerospace technology is their ultimate goal. I don't know if you remember, back in the 1990s, Taiwan Aerospace actually looked at buying Douglas Aircraft. I was monitoring that effort, and I asked them "why would you ever want to do that?" Their answer back was not, "because I want to get into the aerospace business, but because in getting into the aerospace business," but because in getting into the aerospace business, it required such a higher level of quality, precision engineering that that those higher levels of skills were thought to be able to bring up the rest of the economy—where they would really be making money, such as in hard drives, et cetera.

I think there's a similar phenomenon that's going on in China as well. It's not necessarily the interest in aerospace per se. It's what does it do in terms of helping improve engineering skills, talents, precision quality manufacturing on a broader basis, with an ultimately commercial mind-set of, "okay, it makes me make better PCs."

Cochair WESSEL. Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you, Mr. Chairman. Thank you to all of our witnesses. This has been very interesting. Dr. Shilling, I was very interested in what you said. I think you said it was ATI that the Chinese tried to get proprietary information out of you in exchange for access to their market? Did I hear that correctly?

Dr. SHILLING. I didn't say it quite that way. What they offered was a business opportunity, an investment opportunity. Access to the China market for your technology and you'd form a joint venture, for example, to jointly pursue that.

Commissioner BARTHOLOMEW. And you said you declined that opportunity?

Dr. SHILLING. Correct. More than once. To more than one SOE in China.

Commissioner BARTHOLOMEW. So can I presume that you have not been able to get access to some of those opportunities because you——

Dr. SHILLING. That's an interesting question. No. Actually, we have continued and reported this publicly to increase exports of the export-compliant, civil-related specialty metals into China.

So if you look at the exports out of our U.S. manufacturing operations into China, they've been increasing significantly.

Commissioner BARTHOLOMEW. So it was perhaps a negotiating fence, but you have product that they want?

Dr. SHILLING. Absolutely.

Commissioner BARTHOLOMEW. Yes.

Dr. SHILLING. And they can't make it.

Commissioner BARTHOLOMEW. And they can't make it, which makes you quite different than a number of other companies who get put into that kind of position——

Dr. SHILLING. Correct.

Commissioner BARTHOLOMEW. —and feel coerced is perhaps too strong of a word, but feel pressured to have to make decisions that transfer proprietary information.

Dr. SHILLING. Yes, but I don't want to present that as a simple decision. It's also one that changes with time. In other words, if that decision was the correct one to have been made whenever it was made, what if the same question gets posed next year? What if it gets posed the year after that? Because the market keeps changing. Now the Chinese market is ten times bigger than it was before.

Commissioner BARTHOLOMEW. Yes. The reason I'm pointing it out is because we've heard for a number of years rumblings that there are technology transfer requirements that are going along, and there are very few people who actually stand up and say this is how people tried to do it. So I thank you for acknowledging publicly that that's some of what is going on.

Dr. Freedenberg, you actually started saying this at the luncheon. I'd love for you to elaborate on the consequences of if we get put into a wartime situation the inability to get access to the materials or the products that used to be made here but now are no longer being made here. Could you elaborate on that?

Dr. FREEDENBERG. I tried to make the point in my testimony, that our assumptions until I think this Administration—it might have gradually happened during the Clinton administration, as well—is that we don't have to worry about the sea lanes anymore, and therefore we don't have to be autarchic. We don't have to have the capacity here. We could have much more off-the-shelf approach to defense equipment and stockpiles of materials.

So that means that we're making some assumptions there because obviously we're not self-sufficient in a number of, for example, specialty metals as it was just talked about. And we saw in the Iraq War one case where a supplier didn't agree with us, and was slow to resupply us.

They're now arguing about how slow they were, I've heard various explanations of it, but the potential was that we would not get a key component of an important weapon because of disagreements with foreign suppliers. So that's something we really need to take into account.

I think it's too bad the Defense Department isn't here because it would be interesting to hear their answer to that. Their assumption is we can always get this re-supply. We don't have to worry about sea-lanes, air lanes, and we don't have to worry about not getting whatever we need from abroad. We don't have the two-and-a-half war scenario either as an input/output model.

All those things have changed. They have changed since the Reagan administration when I had access to this planning. I'm not guessing at it. It was said publicly by U.S. officials.

Commissioner BARTHOLOMEW. Dr. Freedenberg, at lunch you said something along the lines of one of the presumptions that we've worked on is that we will be able to get what we need from our allies.

Dr. FREEDENBERG. That's right.

Commissioner BARTHOLOMEW. I'm picking the word "allies" specifically here too in the context of are you comfortable that our allies, that there is enough production capacity among our allies, however we happen to define that at any given time?

Dr. FREEDENBERG. I think it has more to do with will than production capacity. Will they want to re-supply us, and we have used our re-supply capability with our allies historically for political leverage. Look at our ability to influence Israel during the '73 war because we were supplying them with their shells for their artillery.

We have great leverage. Now we're putting ourselves into that situation. We are assuming that our allies will without condition, without question, re-supply us. I'm just pointing that out.

Commissioner BARTHOLOMEW. Mr. Chao, you look a little skeptical about that response.

Mr. CHAO. I think we have to be a little bit careful in terms of crossing the line into autarchy. That's always been the dream of any government since the beginning of time, autarchy. It's been

rarely achieved. We had visceral disagreements with the French and German governments and yet every single one of their suppliers did deliver during this last conflict.

Now that doesn't mean that will always be the case. But my concern is that when you try to go down the path, that in the desire to create autarchy, you prevent things from coming in, which has been absolutely vital for. So I think the issue becomes you can't be autarchic in everything.

It raises the central questions of deciding what is strategic and what does the value chain look like, so you can identify what is strategic. Because in the absence of deciding what is strategic, we get buffeted by, with all due deference to everybody in the room behind me, the lobbyists of the moment who happens to scream about this or that. It becomes very difficult to say, "Yes, that is an important thing. I should be protecting, let's say, semiconductors versus something else," I'm not going to mention the something else because I'll get a phone call from an angry trade association for naming them, that becomes the central strategic dilemma.

Commissioner BARTHOLOMEW. I would just add one question to the list of questions that you have, which is it seems to me it's one of the elephants in the room which is as more and more production capacity is shifting to China. Is China an ally, and is it an ally that we would be able to rely on in the event that we got into a conflict? You don't have to answer that. I'm just going to put it on the table.

Thank you.

Cochair WESSEL. Commissioner Mulloy can either choose to answer that or ask his own questions.

Commissioner TEUFEL DREYER. Shame on you for giving him the option.

Commissioner MULLOY. Thank you, Commissioner Wessel. I wasn't here during your formal presentations. I have read your testimony, and I wanted to pick up a larger issue and hopefully you can talk about it.

Dr. Shilling, you spoke about how China's approach is systematic, highly coordinated, strategic. Paul Freedenberg talked about China's economic strategy. Mr. Lewis comes in later and talks about the Chinese governments, particularly at the provincial and local levels, have used subsidies aggressively to attract foreign high tech investment. It sounds to me like they've got a strategy. What I picked up in working in this area now is that China is part of a larger globalization issue, and that the multinationals are driven by market forces that require them to do some things that we've been told may not be necessarily in the national interest, but they've got their own interests they've got to pursue. That this understanding of how our system works, the Chinese have a pretty good understanding of it, and they've supplemented that by policies that help move market forces to move our industrial base across the Pacific.

Dr. Freedenberg talks about how this has been further supplemented by exchange rate manipulation policies, which further add to the forces moving the industrial base.

We had an interesting hearing in New York where we looked at the role of the retailers, Wal-Mart and others. They play a role in the moving of the industrial base out of the country as well.

I once worked in the export control area when I was Dr. Freedenberg's colleague on the Senate Banking Committee staff, and we always understood that machine tools were important for our defense base, to have those capabilities.

But if the manufacturing base moves out of your country, your machine tools necessarily have to move with it; right?

Dr. FREEDENBERG. Yes.

Commissioner MULLOY. So the question I keep coming back to is, does the United States at a national level need to start thinking strategically and comprehensively about what we're doing in this global economy. I'd ask each of you that. If so, can you help us start thinking about the key elements that should be in such a strategy? I'll start with my old colleague, Dr. Freedenberg.

Dr. FREEDENBERG. Well, one thing you don't have to have is a built-in subsidy for the Chinese economy, which is why I brought up the exchange rate situation, which they have. That obviously is an incentive for industry to move there, and we're talking about what's a good investment.

Obviously, if you're getting access to a very large market, and you're getting low labor, and you're getting perhaps as high as a 40 percent subsidy, it's a pretty good deal. It's pretty attractive.

So you want to certainly get rid of the subsidy part of it. You also have to think about what are key industries and what are strategies. Nobody likes to talk about industrial policy, but when I was working at the Commerce Department, Secretary Baldrige said we're not going to lose our semiconductor industry. We were on the verge at that time of losing key semiconductor companies. Intel, TI and Motorola were in pretty bad economic situation.

We had the Fujitsu-Fairchild deal—one of the founders of U.S. semiconductor industry was on the block, and Secretary Baldrige decided to make an issue of it because he thought there was unfair subsidy involved in the Japanese approach.

So he had a plan. He didn't have an overall plan, but he had decided that certain industries were important to keep and certain industries should not move offshore. I think we have to have a government at least aware of it. Particularly in the area of our passivity, official passivity with regard to the exchange rate. We really don't have much of a strategy. We have some rhetoric, but we don't have a strategy.

Mr. CHAO. I think the answer has to be a resounding yes. In some ways, the simplest actor in all of this is industry because they have very simple motivations, and we all know what they are and they've been time immemorial. It's ironic—look at the Chinese strategy towards the semiconductor and the interlocking incentives that they have put into place. I find it ironic that a bunch of Communists figured out how to set up a group of capitalistic incentives that make it almost impossible for any sane CEO not to take their offer. So the ability to do that and to have a strategy—I don't like the notion of industrial policy, with a capital "I" and a capital "P" that picks and chooses winners—but in terms of setting the business environment is important.

I think the other element where you want to examine is the fact that we need to find another entity besides DoD to keep trying to solve some of these problems. In some ways it becomes too easy,

to keep turning to DoD, particularly when they only end up representing three percent of the market. In some of these areas, you're brute forcing—you're trying to brute force your industrial policy on broad areas of the economy through DoD, which is not going to work.

Cochair WESSEL. I apologize. We're running out of time and Commissioner, we have two other Commissioners, Commissioner Reinsch.

Commissioner MULLOY. Did Dr. Shilling have a response?

Cochair WESSEL. I'm sorry. Did you have a quick response?

Dr. SHILLING. It's my favorite question. I'll be extremely brief. I've learned in the last year that industrial policy with a big "I" and a big "P" is just not a good idea, not salable politically. But I couldn't agree more with what Mr. Chao said. What's so frustrating to me as an American citizen is to read the papers and see no effort in terms of the Administration and Congress to come up with what I would call an industrial policy or an industrial strategy, which is not to pick winners and losers.

It's to get the energy costs down to where they should be, enforce our trade laws, get rid of this insane currency situation in China. These are not picking winners and losers. This is creating an environment that will encourage, and it will work—believe me it will work—encourage investment in research and development and raw manufacturing capacity here. Because the environment is awful.

If you're a manufacturer, there is a long list of reasons why you wouldn't want to spend money here. So that's what we have to do.

Commissioner MULLOY. Thank you.

Cochair WESSEL. Commissioner Reinsch.

Cochair REINSCH. Thank you. I think Mr. Chao's point about autarky is exceptionally well-taken. The only country I'm aware of recently that's deliberately pursued a policy of autarky is North Korea, and I don't think that's a model that is worthy of emulation. I also want to second Mr. Bryen's comment that Dr. Freedenberg was a great Under Secretary of Commerce.

Dr. FREEDENBERG. Thank you.

Cochair REINSCH. Perhaps not the greatest, but certainly a great one.

Dr. FREEDENBERG. Okay.

Cochair REINSCH. And I want to try to weave that experience in with your current job and ask you to elaborate a little bit, Paul, on the comments in your written statement on export controls. Your industry a classic case of one where we've imposed export controls in an effort to maintain the crown jewels if you will and the technology leadership here, yet the act of doing that may very well have accelerated giving it away rather than maintaining it.

Can you comment on the role of export controls and how they've enhanced or not enhanced your competitiveness?

Dr. FREEDENBERG. It has not enhanced because the problem was, as I mention in my testimony, was that just as we got rid of our unit veto system, our single country veto system within CoCom, we got tough on, particularly on machine tools because we decided manufacturing technology was among the most important to retain under export controls.

But we didn't get the cooperation from particularly our European allies, and so in the market that was growing the fastest for machine tools, it should essentially shut us out, which also meant shut us out to a large extent, not entirely, which meant that we were less attractive as partners in that area.

We have a very small percentage of the market and part of it is to the unreliability of getting American machine tools. If you're under demand, if you have huge growth of your industry, which China has had, the last thing you want is an uncertain supplier, and that's what the U.S. became, and unfortunately, if were trying to do it for strategic reasons, we certainly should have gotten consensus with our allies because we didn't accomplish anything by doing it unilaterally.

Cochair REINSCH. Yes, I think that latter point is particularly important. We always ought to look at the effect of your policies, and here is a case of a policy that may have been well intended and certainly had a noble goal but was unsuccessful from both perspectives.

Time is short. I think I'll stop. Thank you, Mr. Chairman.

Cochair WESSEL. Commissioner Dreyer.

Commissioner TEUFEL DREYER. Yes. Dr. Shilling, I think I heard you say—please correct me if I'm wrong—that you thought it was naive to think that production technology can be shipped to China, but that the leading edge technology can be kept here. Is that more or less correct?

Dr. SHILLING. Almost right. What I said is it's naive to think that you can move the production to China and develop the technology in a laboratory here in the United States. That doesn't work.

Commissioner TEUFEL DREYER. Fair enough. Now that Bill Reinsch has ruled out autarky, and we know that it really is wise to move factories to China or somewhere like it for various different reasons—in any case it seems inevitable whether we like it or not—that seems to lead to a very unpleasant conclusion. Do you want to——

Dr. SHILLING. It's an easy one for me to answer. I've been thinking about it for two years. It's just like everything else in life. It's balance. You don't want to move all of anything to China. If the U.S. keeps a significant manufacturing base here across all of these important industries, and we'll let somebody else figure out what they are, but one of them is specialty metals, and encourages the ongoing education of our folks because we're losing—not enough engineers are graduating. As long as we have a healthy vibrant manufacturing base, we will stay ahead for a long time. At least the year when China passes us up in technology is going to go out by decades. I won't be here anymore.

But if we're not capable, when that crossover point occurs could be very soon at the rate we're going. So it's balance. Investment here. Let the multinationals invest overseas as well.

Commissioner TEUFEL DREYER. Thank you.

Cochair WESSEL. There were a few Commissioners that had very quick follow-up questions I believe. Commissioner Becker.

Commissioner BECKER. Dr. Shilling, you mentioned titanium, and we've talked quite a bit about that as a strategic metal. The government used to maintain a stockpile.

Dr. SHILLING. Absolutely right.

Commissioner BECKER. What happened to that?

Dr. SHILLING. You got me. Ask yourself a question. It's a critical material. One point in time somebody thought it was important to have a stockpile of it, and they just sold—I don't know exactly how much is left, but my understanding is not much. I don't know why that was.

Commissioner BECKER. My understanding is none. My question, though, to you is should we maintain a stockpile on strategic metals like that?

Dr. SHILLING. I'm not an expert in that area, but I would say yes.

Commissioner BECKER. Thank you.

Cochair WESSEL. Commissioner Wortzel, a quick question.

Cochair WORTZEL. Quick question. According to a couple of news articles in the past or last week, the Defense Intelligence Agency and the Central Intelligence Agency missed ten years of Chinese military build-up, particularly in the naval field. And all of a sudden a few analysts took a look and said, my God, how did this get by us; they're way ahead of where we thought they'd be. Now, I'll ask this of the shipbuilding panel because it was mostly naval, but have the Chinese or are the Chinese making very rapid advances that perhaps we're missing in the aerospace field in applying specialty metals and new materials to be able to produce jet engines and things like that?

Dr. SHILLING. What I know about the Chinese shipbuilding industry is what was stated here earlier by others. They are investing huge amounts of manufacturing capacity to make products to build ships.

To the best of my knowledge, though, they do not have the technology to make the most advanced kinds of specialty metals for those applications.

Mr. CHAO. I think the same is true in the aerospace. Most people would say they're probably in the 1980s, maybe they're in the early 1990s, in terms of capability. I think the places where I worry more is where they're doing some basic science and technology investment in next generation technologies—the amount of money they're plowing into nanotechnology. I think this gets to Commissioner Dreyer's question on the way you stay ahead is by investing in seed corn technologies that allows you to leap ahead.

So if they're moving ahead in semiconductors, then we better be the first guys in optical chips, et cetera, et cetera, et cetera. That's the answer out. Otherwise you're stuck in that trap of trying to catch up.

Cochair WORTZEL. Thank you very much.

Cochair WESSEL. Commissioner Bartholomew.

Commissioner BARTHOLOMEW. First, I thank all of our panelists, but the question is actually to Commissioner Reinsch. For the benefit of our audience, Commissioner Reinsch, if Dr. Freedenberg was not the best Under Secretary of Commerce, who do you want us to believe was?

Cochair WESSEL. You can submit that for the record. Thank you all. We appreciate your time and you clearly can see our interest.

PANEL V: THE IT, SEMICONDUCTOR, AND SHIPBUILDING INDUSTRIAL BASE

Cochair WESSEL. If the next panel could get seated. In order to give time for our technology to work, I'm going to change the order, so Dr. Howard you can work on your equipment for a couple of minutes.

We did the introduction of the last panel. You could tell the interest among the Commissioners in asking questions, so I'm going to be fairly restrictive in terms of your opening statements and keeping them to seven minutes. Dr. Lewis, if you're prepared to go first, we'll start with you.

STATEMENT OF JAMES A. LEWIS
SENIOR FELLOW AND DIRECTOR
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Dr. LEWIS. Thank you and I'd like to thank the Commission for inviting me to speak and for considering this very important topic. I was asked to speak about the implication of the growth of China's high-tech industry for the U.S. defense industrial base, and in particular information technology, deficiencies in the U.S. high-tech industry that could be detrimental, and how U.S.-China trade and investment will change the U.S. defense industrial base and high-tech industries.

The underlying question is really whether China's growth in modernization, particularly its high-tech growth, is hollowing out the U.S. defense industrial base, and my view is that that is not the case. There are new areas of risk for the U.S. defense industry, but these stem from larger trends where China is a symptom more than a cause.

The areas where there is risk, I think, stem from the growing international economic integration known as globalization, the related issue of the diffusion of scientific and technological capabilities around the world, and the state of the arms market in general, the defense industry in general, including the general decline in demand for advanced conventional weapons.

There are three specific areas of risk that I think we need to look at: whether changes in research and development around the world put the U.S. at risk or at a disadvantage; the potential effects of the shift in manufacturing to Asia on U.S. innovation, and some of the previous speakers touched on that; and finally the possible risk to U.S. security resulting from the globalization of the supply chain.

None of these problems are insurmountable if the U.S. takes action to address them, and for me the real issue is not China's growth, but whether the U.S. responds in a timely fashion to a new international security environment.

Let me talk a little bit about the defense industrial base. The change in this and the technology of the defense industry has been remarkable in the last decade or so. The key skill now for weapons producers is the ability to design a system, assemble subcontractors, and then integrate components and subsystems into a functional weapon. It's the integration skills that are most important. It's the technological know-how.

These are skills and information that require many years of experience. Access to a strong civil manufacturing base, while an asset, doesn't really guarantee success in the defense industry. At this time, only the U.S., Russia and Europe are capable of producing advanced military equipment. China is not among these, and this limits the effect of China's high tech industry on our defense industrial base.

I should note that, in general, the U.S. defense industrial base is not dependent on foreign suppliers. But there are areas of risk that we should talk about, in which China does play a role. These areas of risk include the effect of the shift of manufacturing on innovation. The Commissioners heard one of the earlier panelists say that if a country is no longer in manufacturing, it would no longer be innovating. I don't think that's right. I think it becomes more difficult to innovate, and so one of the things we need to think about is how do you compensate for that decline in manufacturing?

There is also the risk of the decline in research and development in the U.S. Again, previous panelists touched on this, but I'd like to talk about possible U.S. responses.

Some of what we're witnessing is a transition in the U.S. economy from an industrial to an information economy. That means manufacturing is less important, and absent compensatory measures, this transition to an information economy could decrease U.S. technological strength.

Innovation comes from a number of sources. Manufacturing is one of them, but only one, and in response to the growth in China's manufacturing capabilities, the U.S. will need to reinforce other sources for technological innovation. I think that would be the area that we should really concentrate on in responding to China's growth and to these larger international trends.

Globalization also gives potential opponents increased access to U.S. infrastructure and U.S. technology. This creates a new set of risks, particularly in information technologies. One risk I'd put before the Commission for their consideration are the sale of intentionally flawed products for later exploitation. This is whether people build in backdoors or other things that would give them the opportunity to disrupt or to gain information illicitly.

A second area of risk is the dependence on foreign supplies. Assessing the potential risks created by the globalization of manufacturing is difficult and managing them is a complex subject, but in both cases, I don't think that these are particularly great risks at this time for the U.S.

The question is how do we manage the risk we do face with minimal economic disruption, and in that light, I wanted to touch briefly on the case of Lenovo, formerly Legend, one of China's leading computer manufacturers. When the Lenovo sale was announced, there was some concern in the U.S. I thought this concern was misplaced.

I thought it was misplaced for a number of reasons, but the most important was is that the vast majority of laptops and PCs sold in the U.S. are already assembled in China. They're assembled in China from parts imported from other countries including the United States, and so the extent that the name on the outside of

the box is now a Chinese name rather than that of a U.S. company, the technological risks for the United States are not increased.

At this time in information technology, the greater risk lies in the use of viruses and spyware that give a potential opponent the ability to gain access to sensitive industrial information from the United States.

The long-term risk for the United States is in the erosion of the its high-tech industry. There are several things that contribute to this. First, as you've heard in some of the earlier panels, U.S. regulations and policies. Those would include export controls, some of the things we're doing in homeland security.

Second is the growth outside of the U.S., centers of scientific and technological excellence. In China's case, as has been mentioned, this was an intentional policy. In 1986, four leading Chinese scientists went to Deng Xiaoping and said we are falling behind the West; we're going to be backwards, they're going to surpass us. He created something called the 863 Program in March 1986, and that has been actually relatively successful in creating a strong human capital base in China.

I would focus more on what the U.S. does in response to make sure that we maintain innovation and for me that would include focus on R&D, increasing basic research, building up our scientific capabilities, looking for ways to take advantage of foreign technological developments and finally coming up with some better process to assess risk in the United States to these things.

With that, why don't I stop and save any further remarks for questions.

[The statement follows:]

Prepared Statement of James A. Lewis
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Effect of U.S.-China Trade on the Defense Industrial Base

The Commission has asked about the implications of growth of China's high-tech industry for the U.S. defense industrial base, and in particular, deficiencies in the U.S. high-technology industry that could be detrimental to U.S. defense capabilities; the process for monitoring the effect on the U.S. high-tech industrial base, and in turn, on U.S. security when U.S. firms outsource work abroad for defense contracts; and how U.S.-China trade and investment change the U.S. defense industrial base in general and the high-tech industry in particular.

The underlying question is whether China's growth and modernization, particularly its growth in the high-tech and information technology sectors, is 'hollowing out' the American defense industrial base. This is not the case. While China's manufacturing capabilities play a growing role in supplying consumer products, they are insignificant contributors to U.S. defense technology and this is unlikely to change.

There are new areas of increased risk for the U.S. defense industry. These stem from larger trends where China is a symptom more than a cause. These larger trends are the ongoing international economic integration known as globalization, the related issue of the diffusion of scientific and technological capabilities around the world, and the general decline in demand for advanced conventional weapons. The effect of these trends is that if the United States relies solely on the policies and practices that made it strong in the 1980s and 1990s, it is likely to face increased risk to national security.

Globalization and technological diffusion produce three areas of risk for the defense industrial base. These areas of risk are the changes in research and development efforts that may put the U.S. at a disadvantage; the potential effects of a shift in manufacturing to Asia on U.S. innovation; and finally, possible risks to U.S. security resulting from the globalization of the supply chain for information technology.

None of these problems are insurmountable if the United States takes action to address them. The real issue is not China's growth but whether the U.S. can respond in a timely fashion to a new environment for international security and economics. Success is not guaranteed: in the 1970s, the U.S. did not adjust to a new international environment and as a result endured a decade of economic and military weakness.

As in the 1970s, the United States again faces a complex new international environment. It has gone from leading an alliance of Western democracies in a global defense against a superpower foe to a world where alliances are less cohesive and threats are more diffuse. The immediate threat lies with terrorism, weapons of mass destruction, and problematic non-state actors, but the long-term strategic challenge lies with the emergence of powerful new states. This strategic competition is not a traditional security problem and it is not fully recognized by the policy community in the United States. The new competitors are a number of large nations, among them China, who see themselves as challenging the U.S. now or in the future for economic power, international influence and regional or global leadership. This is not a military struggle, although military strength is an aspect of the competition and in China's case, military conflict cannot be ruled out.

China is the emerging power of greatest concern, because of its rapid growth, its perceived ambitions and because of the potential for conflict over Taiwan. The hopes that a wealthier, market-oriented China would become a stable democracy have not yet been fulfilled. China's assurances that its intentions are peaceful are undercut by its military growth. Economic interdependence between the U.S. and China continues to grow, but this is not matched by an increase in trust.

The risk of transferring U.S. commercial technology has been a staple of the larger U.S. debate over China policy for many years. Trade with China is routinely viewed through the prism of Chinese military capabilities, but there are now growing concerns that trade and investment with China is eroding the U.S. manufacturing base, creating unemployment and long-term security problems. Public and Congressional attitudes reflect a deep ambivalence about trade with China. However, this ambivalence is not sufficient to overcome the economic forces that will lead to greater integration of the two economies.

To understand the implications of China's economic development for the U.S., it will help to list the elements of a modern defense-industrial base. A mass production/heavy industry defense industrial base is no longer adequate for military superiority—this is not World War II and we are not building Liberty Ships. Many factors determine the strength of a national defense industry, and the connection between the civilian economy and military capabilities is complex and nonlinear.

These include national research and development (R&D) capabilities and, equally important, the ability to turn scientific research into commercially and military useful innovations. A strong defense industry capable of building innovative equipment requires extensive databases with information on testing and past projects and years (if not decades) of experience. It requires strong integration skills—the ability to pull many disparate systems into a coherent and effective weapon. It requires the ability to draw on a broad national and international supply chain for critical components especially for specially designed military components. It requires access to advanced technology for materials, sensors, software, microelectronics, and manufacturing. Finally, a strong defense industrial base requires a skilled science and engineering workforce of adequate size to support both defense production and economic growth.

The key skill for a weapons producer is the ability to design a system (itself a complicated process), assemble subcontractors, and then integrate components and subsystems into a functional weapon. Only a handful of companies around the world can do this. A strong civil manufacturing base, while an asset, does not guarantee success. These skills and information require many years of experience with weapons programs.

For the United States, China's growth affects very few of these factors. The consumer oriented industries where China has gained ground are not crucial for modern defense systems. China is not in a position to supply advanced weapons or the components needed to build them. While Europe, Japan and the U.S. provide industrial technologies to China, the ability of the PLA and China's defense industry to absorb these technologies remains mixed, despite China's general economic progress. China cannot yet depend on its defense industry to produce modern weapons or the components for modern weapons.

Trade brings China access to advanced technologies, but it lacks the information, testing and integration skills that are the most important factors for success in making advanced weaponry. These skills can only be obtained after years of experience with weapons programs. China lacks this experience. Its emphasis from the

1950s until the 1980s on low-tech warfare cost it a generation of weapons experience. Given this, the Chinese appear to be following a three pronged approach: modernize their military now through foreign acquisitions; emphasize research in asymmetric weapons for near-term advantage; and pursue long-term economic growth to provide an adequate industrial and technological base for a modern arms industry.

Modernization of China's defense industry requires the acquisition of capital goods and technological 'know-how' needed for the industrial base that could support modern weapons programs, along with investment in R&D centers to design indigenous military technologies. In this regard, the most sensitive items that China could acquire from foreign companies is not actual goods but "technology," specifically the information necessary for the development or production of a product. This information takes the form of technical data or technical assistance. Previously, China made technology transfer a key condition for entry into its market, but WTO adherence has reduced these forced technology transfers, especially as more foreign companies open wholly owned facilities rather than entering into partnerships with Chinese firms.

The state of the global arms industry also reduces the importance of China's manufacturing growth for the defense industrial base. With the end of the Cold War, demand for major or advanced weapons fell precipitously. At the same time, the complexity and cost of modern weapons continues to increase. This combination of cost and complexity progressively shrinks the number of nations able to build advanced weaponry. The combination of increased complexity and defense spending cuts persuaded many nations that they could no longer produce modern weapons systems. The most telling affect was on a number of emerging economies that had entered the arms market. Brazil, India, Taiwan, Korea, Israel, Pakistan and South Africa all began major arms programs in the 1970s and 1980s, such as main battle tanks and modern combat aircraft, often complemented by strategic weapons programs. Even when there was substantial foreign assistance, these countries (despite the alarm with which their entry into the market was greeted by Western observers), proved unable to sustain their programs.

The result was that a large number of producers exited the industry in the 1990s. They were unable to bear the development costs of next generation systems, or, in those cases where they persevered, the systems they developed tended to be expensive, underpowered variants of modern weaponry. Some countries, such as Israel, adopted a more effective strategy of pursuing excellence in specific niches of the defense industry. At the end of the day, only the U.S., Russia and Europe are capable of producing a range of advanced military equipment. In some instances, such as high performance jet engines, the cost of development is such that the few firms in these areas must work in international partnerships to be able to afford a new program. China would need to break into this inner circle of arms producers and form partnerships with the leaders to gain modern defense-industrial capabilities.

This is particularly true for combat aircraft. The difficulty of sustaining a modern combat aircraft industry drove even advanced economies from the market or led their firms to consolidate. Sweden, for example, exited after producing a fourth generation fighter,[1] the Grypen, but more than a third of Grypen's components (the engines and avionics) were U.S. Other European firms consolidated into a few large defense conglomerates. In China's case, the F–10 fighter program came from this era of failed national programs. Even with substantial foreign help in design, engines, and avionics, the F–10 first entered the arena in the 1990s as an underpowered 1970s fighter. China had to redo the entire program after more than a decade of work and is now producing a middling fourth generation aircraft.

Any dependence by the U.S. defense industrial base on Chinese manufacturing would thus appear only in preliminary stages, involving dual use or commercial components. This alone limits risk. However, as noted earlier, maintaining U.S. defense industrial strength does face three risks where China plays a part. These are the potential effects of a shift in manufacturing to Asia on U.S. innovation; possible risks to U.S. security resulting from the globalization of manufacturing; and most significantly, the risk of decline in research and development. The following sections briefly discuss these topics and possible U.S. responses.

Manufacturing and Innovation

The U.S. and other economies are in transition from an industrial to an information economy. In an information economy, the creation of new ideas and services will generate greater returns than manufacturing or agriculture. From this larger perspective, the increase in manufacturing in Asia is a positive sign of U.S. eco-

[1] The first generation of jet combat aircraft date from the Korean War. Fourth generation aircraft would include the F–16 or the Su–27.

nomic activity moving to areas of higher return. However, there will be an inevitable effect on the U.S. industrial base because of this transition. The risk lies in the relationship between manufacturing and innovation. Those who make a product are more likely to discover ways to improve it. As manufacturing shifts to Asia, research and innovation will follow (particulary if there is a strong scientific workforce to welcome it). Absent compensatory measures, the transition to an information economy and the flow of manufacturing of Asia will decrease U.S. technological strength, particulary in comparison to China.

Innovative new technologies come from several sources. In response to a decline in manufacturing, the U.S. could reinforce other sources for technological innovation. One source is particularly important because it provides the U.S. with comparative advantage. This is the combination of university research programs, entrepreneurs, and financial support (from venture capital, corporations, or governments) provides are a strong source for innovation. The small, new firms created by this combination are often more productive in the creation of new products and services than larger firms. Examples of this 'system' include the research triangle in North Carolina, Silicon Valley and the area around MIT. This blend of science and engineering expertise with entrepreneurial skills and capital is a leading source of innovation for the U.S. One sign of its success is the effort by many countries to create similar centers around their own universities.

This model is neither perfect nor widespread, but a strategy to reinforce and expand it could maintain technological leadership. One way to do this is to strengthen advanced graduate level programs in science and engineering. U.S. graduate programs are world leaders. Ensuring that these graduate programs remain strong is an achievable national goal. Despite concern over the decline of U.S. primary education in science and math, primary education or even undergraduate level education will not be the source of technological innovation. New ways to keep U.S. graduate programs strong and to ensure that the ideas they generate flow into economic activity will help maintain technological leadership.

Supply Chain Risk

Globalization, by giving potential opponents increased access to U.S. critical infrastructure, creates a new set of risks, particularly in information technologies. One set of risks involves the sale of intentionally flawed products for later exploitation. The other set of risks involve a fear of 'dependence' on foreign suppliers. Information technologies deserve special attention because of the central role they play in military transformation.

Assessing the potential risks created by a reliance on a global supply system for advanced technology and determining how to manage those risks is a complex subject that can be dealt with here only in a summary fashion. Neither set of risks are particularly great. Other nations face the same challenges. The question is not how to eliminate risk but how to prudently manage it with minimal economic disruption.

To put this in perspective, it may be useful to consider the recent purchase of IBM's personal computer division by China's Lenovo (formerly known as Legend). Lenovo's purchase of IBM's PC division attracted considerable attention. At first, some observers mistakenly believed that IBM was selling its supercomputer division, but in fact, the transaction involved no sensitive or advanced technologies.

Legend was founded by a researcher from the China Academy of Sciences and CAS still owns shares in the company, which is traded on the Hong Kong Stock Exchange. Legend gained market share rapidly in its first years selling low-end PCs. Some Chinese consumers preferred Legend because it provided local support in Chinese. Several large U.S. firms aided Legend in making its computers by providing assistance in integrating CPUs', motherboards and software.

After becoming the leading PC seller in China, Legend decided to diversify its product line and move into global markets. It changed its name to Lenovo as part of that global strategy, but in 2003, it was forced to retreat. Lenovo's chief weaknesses were its lack of marketing and distribution skills to sustain a global presence. Individuals involved in the transaction say that Lenovo's motives were not to obtain computer technology but to acquire the global marketing and business skills Chinese firms often lack.

One factor often overlooked in the discussion of Lenovo's purchase is that the vast majority of laptops sold in America are already assembled in China from parts imported from the U.S., Taiwan and other Asia-Pacific economies. The production process for computers is distributed throughout the Asia-Pacific region. To the extent there is any risk involved in using laptops assembled in China from components made in three or four other countries, Lenovo's purchase did not increase it.

Intentionally building flaws into hardware or software for later exploitation is a high risk strategy with uncertain payoff. If discovered, the supplier company could

be forced from the market. The malicious component may not work as planned once it is integrated with components from other sources. Even if it works when it leaves the factory, it may fail later when it is integrated into a larger network. A cursory assessment suggests that the current threat lies in the use of viruses and spyware that exploit software vulnerabilities rather than in malicious changes to hardware or software.

There is also some concern that new risks to security could result from increased U.S. dependence on an international (rather than national) manufacturing base. Western Europe and Japan have provided core manufacturing capabilities for many years, but the U.S could find itself having to rely on suppliers, like China, who are not allies. 'Foreign dependency' does not make the U.S. innately more vulnerable. U-boats are not going to blockade the Pacific Coast nor cut the global supply chain.

The long-term risk lies in the erosion of the U.S. high-tech industrial base as foreign high-tech companies enter and compete in the market. U.S. regulations and policies contribute to this erosion. Many aspects of our export control system fail utterly to keep advanced technology out of foreign hands, yet put U.S. companies at a competitive disadvantage. The net effect is to reduce the number of U.S. defense and high-tech suppliers.

In aerospace technologies, for example, the U.S. decision to restrict exports of space related technologies in the 1990s led Europe to subsidize the creation of its own satellite component manufacturers. U.S. companies now face new competition that is not hampered by regulation in selling to Europe, or to China for that matter. The effect of the regulatory changes of the 1990s was to shift production outside of the United States and to increase China's access to advanced space technologies.

In other sectors, the U.S. faces erosion because of a number of factors. These include not only ill-advised export regulations, but also the decline of our national research base, the globalization of manufacturing and science and, in some cases, foreign government programs to increase their share of manufacturing capabilities. Restrictive policies can damage the country that attempts to implement them, by cutting it off from global flows of ideas, money, and goods. National industries lose access to markets and innovations developed overseas. It compounds the damage if one nation's companies are restricted and their competitors are not. The U.S. finds itself in this situation today.

Industrial policies also will not help deal with the challenge of global manufacturing. Industrial policy substitutes bureaucratic and political processes for private sector decisionmaking and market disciplines. The U.S. has moved steadily away from industrial policy since the 1980s. Private initiative and market forces provide the impetus and direction for economic growth. U.S. policies emphasize less intrusive government, fewer regulations, privatization, and more reliance on markets and competition among private entities. This stands in contrast to Europe, China, or Japan, where the government plays a prominent role in investment decisions for both government and private sector efforts. The U.S.'s market-oriented approach that emphasizes private investment and decisionmaking appears to be more effective. Some analysts, in fact, attribute the U.S. success in innovation and economic growth to the absence of explicit growth policies.

Confidence in this laissez-faire approach can be difficult to maintain in the face of the rapid growth of China's tech industries. This growth raises concern that they may displace U.S. manufacturers, leaving U.S. defense industries dependent of Chinese sources of supply. China's growth is the product of government programs of subsidies and incentives aimed at building a high-tech economy. These began almost two decades ago with the 863 Program, a national effort to expand high-tech research and development in China. The 863 Program and similar efforts have provided China with a large pool of scientific and engineering talent.

The second trend is the decision of many foreign companies to locate in China. The reasons for locating there include lower labor costs, but this is increasingly a tertiary factor. The more important motives are to gain access to both China's expanding domestic market and its increasingly skilled science and engineering workforce. Chinese governments, particulary at the provincial and local levels, have also used subsidies aggressively to attract foreign high-tech investment.

The semiconductor industry illustrates many of these trends. China's national policies call for the creation of a domestic semiconductor industry. This appeared as early as the 'Four Modernizations' development program of the 1970s. China has subsidized both indigenous efforts and foreign investors in its effort to end 'foreign dependency' for semiconductors. The Semiconductor Industry Association reports that there are forty fabs (semiconductor fabrication plants) and six semiconductor foundries in China. Seventeen fabs are under construction in China. Four of these fabs, according to press reports and remarks by company officials, will use current

generation production technologies. However, eight of the ten largest fabs are owned or operated in partnership with Taiwanese, U.S., Japanese or European companies.

China produced over 10 billion semiconductors in 2003, about 2.5 percent of world production. Most of these semiconductors were at the lower end of technology. Total domestic demand in China for semiconductors is expected to continue to grow at 30 percent a year. China's domestic production met only about 20 percent of its domestic demand, but Beijing hopes to raise China's share to more than 50 percent. The Tenth Five year plan called for twenty-five new fabs and a 2000 State Council Directive called for an investment of $10 billion in semiconductors. Since a fab costs between $1 billion to $3 billion to construct, foreign investment will necessarily play a critical part in achieving this goal.

SMIC (Semiconductor Manufacturing International Corp.) is China's largest and most advanced semiconductor manufacturer. SMIC is a good example of the semiconductor industry in China: although located in China, its CEO is Taiwanese, its management and R&D staff a blend of European, U.S. and Japanese citizens, and its customer base is international. SMIC's Chairman lived for several decades in the U.S. where he worked for Texas Instruments.

SMIC received long-term leases at concessionary rates, training subsidies and other incentives from the Shanghai government to locate its fab there. It is the only 'Chinese' company in the top twenty-five semiconductor manufacturers in terms of capital spending. The companies investing the most in new semiconductor manufacturing equipment are from the U.S., Japan, Korea and Taiwan. This suggests that while fabs in China will increase their share of global production, we are unlikely to see all chip production move entirely to China.

China has succeeded in creating a powerful IT industry through a combination of government planning and market forces, but this approach raises the question as to whether the rapid expansion of the industry and its continued growth are sustainable. Both Korea and Japan saw government policy and political interference drive the misallocation of capital in strategies that, in the short term, produced rapid industrialization but in the last few years have worked to significantly slow economic growth. Concern over the continued expansion of China's manufacturing capabilities should be tempered by consideration as to whether its new industries will also follow the pattern set by Japan and Korea.

Concern should also be tempered by the opening of China's economy, including its WTO commitments. As WTO commitments reduce Beijing's ability to extract concessions from foreign investors or to offer some classes of subsidies, many foreign companies are moving from investing in Chinese-owned firms or from partnerships with Chinese firms to opening wholly owned subsidiaries. This means that the high-tech industry in China is not always Chinese-owned.

R&D and Defense

U.S. domestic policies create greater risks for long-term U.S. competitiveness than the rise of China. The most damaging policy involves underinvestment in key research areas: physics, computer sciences, aerospace, engineering. These are the fields that contribute directly to military power and to overall economic growth, but Federal funding for these areas has fallen by half (as a percentage of GDP) since 1970. Corporate R&D spending has changed significantly and focuses on development of new products, in reaction to competitive pressures and the need to show near-term gains to financial markets. While overall U.S. funding for R&D has increased significantly in the last four years, these key areas remain underfunded, particularly for basic research, which is the key to continued technological strength and to the expansion of a skilled science and engineering workforce.

The practice of scientific research (and high-tech industries, particularly in IT), are increasingly collaborative and international in nature. While U.S. universities and labs remain among the leaders in many research areas, they now have numerous foreign counterparts of equal, and in some areas, greater capability. The global scientific and technology workforce is increasingly mobile. This works to the U.S.'s advantage as skilled science and technology workers came here, but changes in U.S. immigration policies reinforce the growing attractiveness of research centers outside the United States.

Homeland security regulations, to the extent they undercut foreign graduate attendance at U.S. universities or make it more difficult to bring skilled workers to the U.S., also damage our competitiveness. This is not intuitively obvious. A simplistic approach would say that keeping foreigners out of our graduate schools, which are among the best in the world, is good for the United States as 'they' are not learning from us. In fact, the damage accrues mainly to the U.S.

We do not generate enough students in the sciences to fill the empty slots in graduate programs. This means that the effect of restricting foreign attendance is to

shrink U.S. research programs. While deep cultural changes and weaknesses in primary education may explain some of this shortage, they are not the primary cause. American students avoid science for sound economic reasons. There are real opportunity costs to studying science. After seven years of difficult and expensive study, a science Ph.D. in the U.S. faces another two to three years in low paid and onerous post-doctoral work. Prospects for employment in many fields of research after the post-doc are mixed. Smart people (or rational actors) will, on average, choose to do something else that is more rewarding.

This is an area of considerable long-term risk for the United States. While Chinese programs smack of the old Soviet-style emphasis on engineering and science, China is rapidly increasing its technological capabilities as a result of having increased the size of its workforce. China is not the only Asian country to have done this, as the Pacific region has become the centre of the global economy and as Asian countries look at the U.S. success in high-tech innovation, and Korea, Taiwan, Japan, and India have all begun to expand national research efforts, build a high-tech workforce and copy aspects of the American system of innovation. To maintain its lead, the U.S. needs to accelerate its own efforts in key scientific areas.

Areas for Response

The issue we face is not primarily the growth of China's industry, but the growth of a global manufacturing and research base and its implications for U.S. technological leadership. The U.S. could respond in several ways to reduce risk. The U.S. will need to develop new strategies and techniques to provide greater assurance in the use of foreign technologies. Policies and regulatory solutions that involve enhancing transparency and setting standards could reduce risk. At a minimum, potential opponents will face a more difficult task if the United States pays additional attention to information security. The most effective response will be to find ways to increase the pace of innovation in the United States, which would make it harder for potential opponents to gain advantage from a global supply chain.

There are two areas where Federal intervention would be useful, as they are areas where the market may not deliver adequate results. The first, as noted above, is in R&D, particularly in basic scientific research. Basic research, particularly in physics, is the ultimate source of the innovations that produce economic and military strength. Industry can no longer afford to fund basic research. The U.S. would benefit if it recast decisions on how to fund basic research as a security issue rather than a matter for science policy.

The second is in monitoring foreign involvement in the U.S. economy. There is no central place in the Federal Government responsible for assessing technological risk or assuring continued technological vitality. Restoration of a Congressional office to monitor technology would do little to improve the situation—this is an executive branch function. Various Departments and agencies—Defense, Commerce, Energy—have fragmentary responsibilities. The current interagency process, the Committee on Foreign Investment in the United States, was created several decades ago and while it performs its assigned tasks well, it does not have the authority or the resources to monitor the full range of foreign activity in the U.S. economy and the implications of this for security.

In many ways, debate over the rise of China and its implications for the U.S. economy bears striking (if unremarked) parallels with the debate of the 1980s over the rise of Japan. A gravitational pull for manufacturing, American companies in desperate competition, a ballooning trade imbalance and exchange rate difficulties were all part of the Japan trade debate. In that case, U.S. fears proved unwarranted, suggesting that some of the apprehension over China is overstated, but the Japan debate lacked the security and human rights factors that make China's growth more of a challenge than the Japanese precedent. In retrospect, however, it was not Japan's growth that created problems, but the sluggish U.S. response. This is a useful precedent in considering how to respond to the new environment.

The United States remains the world leader in the capabilities of its defense industries, in its investment in R&D, and in the size and skills of its scientific workforce. However, China's growth has raised apprehension over the erosion of the U.S manufacturing base and U.S. technological leadership (upon which much of its military superiority depends). Much of this concern stems from exaggerated or mistaken notions, but the U.S. will need to adjust if it is to preserve current levels of security and economic health. There is now some discussion on how to maintain technological leadership in an era of globalization. This discussion is interesting because it looks at strengthening the U.S. rather than trying to restrict China.

Cochair WESSEL. Thank you. Ms. Praeger.

STATEMENT OF AMY E. PRAEGER
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AMERICAN SHIPBUILDING ASSOCIATION, WASHINGTON, D.C.

Ms. PRAEGER. Yes, thank you, Commissioner, and to the rest of the Members of the Commission, I want to thank you for the opportunity to testify on behalf of the American Shipbuilding Association regarding the U.S. defense shipbuilding industrial base.

The American Shipbuilding Association represents the six largest shipyards which build all of the capital ships for the United States Navy and 70 companies that manufacture various ship systems and components and a membership list has been attached to my written testimony.

The U.S. shipbuilding industry employs approximately 350,000 people. The core defense shipbuilding industry is comprised of the six major shipyards and over a thousand companies that manufacture major systems and components and these companies are located across the United States.

Of the six major shipyards, two corporations, Electric Board of General Dynamics and Newport News Shipbuilding of Northrop Grumman, build the nuclear submarines and Newport News Shipbuilding is the only builder of nuclear aircraft carriers.

Bath Iron Works of General Dynamics and Ingalls of Northrop Grumman are the nation's surface combatant builders. Avondale of Northrop Grumman and National Steel and Shipbuilding Company of General Dynamics build the auxiliary ships and Avondale, Ingolls, and National Steel and Shipbuilding Company build the amphibious ships for the Navy and Marine Corps.

If any of these shipyards were to close, it would result in the sole source for a certain type of class of naval ships. For many critical ship systems and components, there is only one remaining U.S. manufacturer in business today as opposed to the 1980s when there three or four.

For example, 80 percent of the Virginia Class submarine is comprised of components that are from sole sources. Production rates are simply not high enough to sustain more than one company and the companies that are left in business are struggling to stay there because of low production rates for all classes of naval ships.

Since 1991, the major shipyards have cut their engineering and production workforces by 24,000, and 120,000 jobs have been lost throughout the manufacturing supplier base. It is estimated that the shipyards will be forced to reduce their workforces by another 13,000 by the end of 2009 and 58,000 individuals are expected to be displaced in the first tier shipbuilding supplier base.

Shipyards and even critical manufacturers could face potential closure. The Department of Defense practice of cutting the number of ships planned to be procured and delaying construction schedules has caused major disruptions throughout the industry and has caused unit prices to rise. Because there is no certainty, shipyards are unable to plan their workloads efficiently, size its workforce to match these workloads and have the confidence to invest in their facilities and new technologies.

For more than a decade, the Department of Defense has been procuring the lowest number of naval ships since 1932. Its average is about six ships a year and again that's just an average. The fis-

cal year 2006 budget calls for the procurement of only four new ships and is $3.2 billion less than the amounts that Congress had appropriated for shipbuilding in fiscal year 2005.

Since 2001, the DoD budget has increased 28 percent, and this excludes supplementals, while the naval shipbuilding procurement budget has decreased by 33 percent. These low rates of production have caused our naval fleet to fall to just 288 ships, a fleet that is 22 ships below the 310 stated as necessary in the 2001 Quadrennial Defense Review.

If budgets stay on their current course, the fleet is expected to be below 200 by 2015. U.S. law requires that ships and certain ship components for our armed forces be manufactured in the United States. The Department of Defense, however, has been working to repeal and weaken these laws through legislative proposals and through rewrites of Defense Acquisition Regulations.

For most ship components and systems, however, there is no law requiring that they be manufactured in this country. Because U.S. naval ships and their systems must meet the highest standards in performance and survivability, U.S. Navy and the U.S. shipyards have by in part relied on American manufactured equipment for ships.

Major ship components, for example, must be shock-tested to demonstrate they can survive enemy fire. These requirements make American ships some of the most survivable in the world, but they also increase the unit cost.

The ship construction standards were demonstrated in 2000 with the attack on the USS Cole. If that ship had been built anywhere else in the world, it probably would not have survived. Foreign manufacturers for the most part do not meet U.S. design and construction standards.

The reliance on U.S. manufactured equipment, however, is dissipating in response to pressure from the Department of Defense to open up competition to foreign sources and to lower military specifications in an effort to reduce its costs.

DoD has been urging defense contractors to rely more on commercial off-the-shelf systems rather than systems built for military specifications. The emphasis on contracting with the lowest cost producer is forcing all member companies of the defense shipbuilding industrial base to source more of its materials, components and systems from foreign sources.

Historically low productions for naval ships combined with increased competition from foreign manufacturers is jeopardizing American skill base and weakening the financial viability of countless companies.

Turning to China, the United States has watched the phenomenal growth since 1989 when China essentially had no shipbuilding market or shipbuilding industry for that matter. In a little over a decade, these last few years, China has invested heavily in its commercial shipbuilding and now is focusing on military shipbuilding. Right now they occupy about third in terms of shipbuilding for commercial behind South Korea and Japan respectively.

What does this mean for the United States as we watch companies manufacturing in China and China focusing on the construc-

tion of a blue water Navy to rival that of the United States? As we start to lose the engineering capacity in this country and the production skills to build our naval ships, it places us in a very dangerous situation becoming reliant upon foreign sources.

For example, this is the first time in 50 years that the United States does not have a new submarine design on the books. And we are placing ourselves in the position of becoming dependent upon—time is telling me it's time to wrap up—how does this fare for the United States? For the first time in 50 years, no new submarine is being designed in this country, and that threatens the future engineering capability of the United States.

Once the skills and engineering production are gone in this country and the companies that manufacture critical systems and components disappear, they are usually gone for good, and it becomes extremely difficult if not impossible to reconstitute, rebuild and retrain and industrial base.

The United States will find itself dependent upon foreign sources, namely China, for systems and components vital to our national defense.

The industry has a couple of recommendations:

The United States should focus on increasing our shipbuilding budget to provide for stable production and predictability throughout the supplier base and also to face the growing threat of China;

And DoD and Congress should require that naval ships and their components be manufactured in the United States to ensure the highest quality to sustain the shipbuilding industrial base. This will assure America's independence in determining its own destiny.

On behalf of the American Shipbuilding Association, I'd like again to thank the Commission for the opportunity to speak before you today and I'd appreciate to answer any questions.

Cochair WESSEL. Thank you and sorry you had to rush. Your entire testimony will be entered and I'm sure there will be a lot of questions.

Ms. PRAEGER. Yes, thank you, Commissioner.

[The statement follows:]

Prepared Statement of Cynthia L. Brown
President, American Shipbuilding Association, Washington, D.C.
Presented by Amy E. Praeger
Director of Legislative Affairs
American Shipbuilding Association, Washington, D.C.

The American Shipbuilding Association (ASA) represents the six largest shipyards, which build all of the capital ships of the U.S. Navy, and 70 companies engaged in the design and manufacture of ship systems and components. A membership list is attached.

ASA welcomes this opportunity to testify on the U.S. defense shipbuilding industrial base and the emerging threat of China. My statement will focus first on the state of the U.S. shipbuilding industry followed by the build-up of the Chinese shipbuilding industry, and conclude with recommended action by DoD to preserve America's defense shipbuilding industry.

The U.S. shipbuilding industry employs approximately 350,000 people. The core defense shipbuilding industrial base is comprised of six major shipyards, owned by two corporations, and thousands of companies that manufacture major ship systems and components. Of the six major shipyards: Electric Boat of General Dynamics and Newport News Shipbuilding of Northrop Grumman build nuclear submarines and Newport News is the sole builder of nuclear aircraft carriers; Bath Iron Works of General Dynamics and Ingalls of Northrop Grumman build surface combatants; Avondale of Northrop Grumman and National Steel and Shipbuilding Company of

General Dynamics build auxiliary ships; and Avondale, NASSCO and Ingalls build amphibious ships. The closure of any of these shipyards will lead to a single shipyard source for certain types of naval ships.

The map below shows the location of the shipyards and the first tier suppliers earning at least $200,000.00 a year in shipbuilding revenue. This map of vendors does not include second or third tier companies engaged in the manufacture of ship systems.

For many critical ship systems and components, there is only one remaining U.S. manufacturer in business today. For example, 80% of the Virginia Class submarine component manufacturers are sole source. Production rates are not high enough to sustain more than one company, and the companies left are struggling to stay in the business because of low production rates for all classes of naval ships.

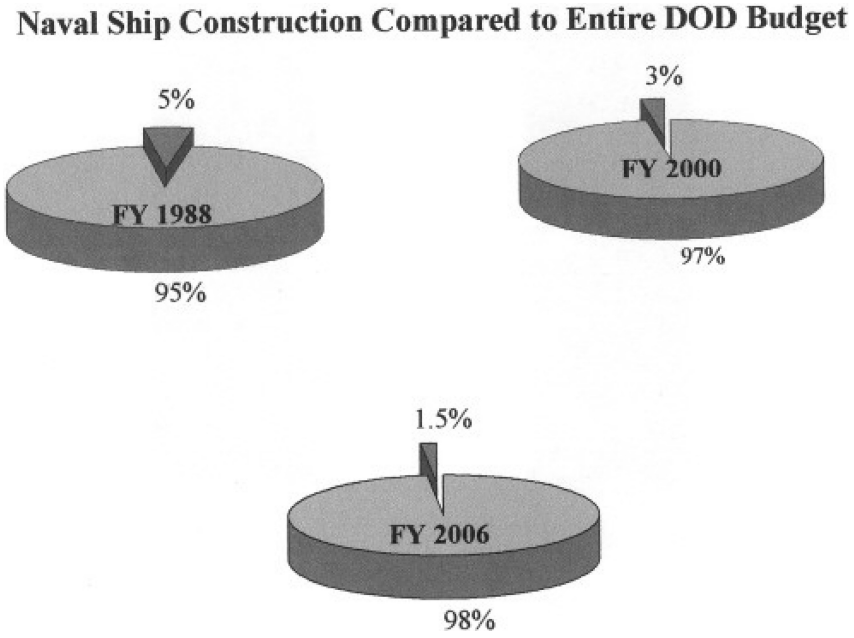
Since 1991, the major shipyards have cut their engineering and production workforce by 24,000 and 120,000 jobs have been lost throughout the manufacturing supplier base. It is estimated that the shipyards will be forced to reduce their workforce by another 13,000 between now and the end of 2009 and that an estimated 58,000 people will be displaced in the supplier base. Shipyards and critical manufacturers face potential closure.

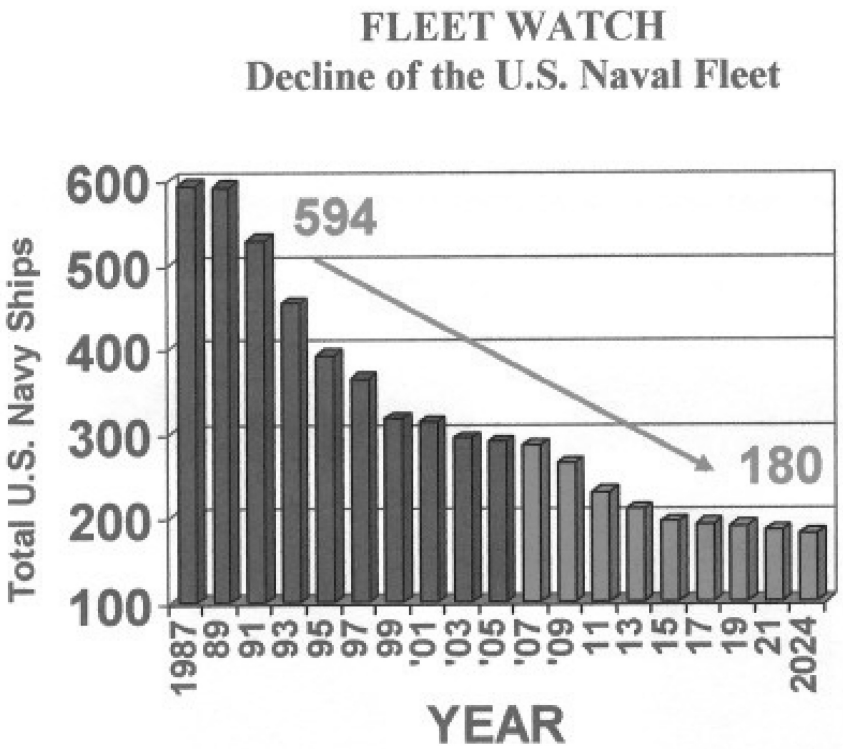
The DoD practice of cutting the number of ships planned to be procured and delaying construction schedules has caused major disruptions throughout the industry and caused unit prices to rise. Because there is no certainty in naval shipbuilding budgets and programs, the private sector is not able to plan its workload efficiently, size its workforce to match a stable workload, or have confidence with respect to facility and technology investments.

Naval Shipbuilding Budgets

For more than a decade, the Department of Defense has been procuring the fewest number of naval ships since 1932. Annual naval ship production has averaged six ships a year. The fiscal year 06 budget calls for the procurement of just four new ships and is $3.2 billion below the dollars appropriated for naval shipbuilding in FY05. Since 2001, the DoD budget has increased 28% (excluding supplementals) while the naval ship procurement budget has decreased by 33%. These low production rates have caused our naval fleet to contract to just 288 ships—a fleet that is 22 ships below the 310-ship minimum fleet requirement identified in the 2001

Quadrennial Defense Review. The fleet will continue to shrink to fewer than 200 ships by 2015.





Foreign Sourcing of Defense Systems

U.S. law requires that ships and certain ship components for our armed forces be manufactured in the United States. The Department of Defense, however, has been working to repeal and weaken these laws through legislative proposals and through re-writes of Defense Acquisition Regulations.

For most ship components and systems, however, there is no law to require that they be manufactured in the United States. Because U.S. naval ships and their systems must meet the highest standards in performance and survivability, the Navy and U.S. shipyards have by and large relied on American manufactured equipment for ships. Major ship components, for example, must be shock tested to demonstrate that they can survive enemy fire. These requirements make American manufactured systems the most survivable in the world, but they also increase the costs of each system. Naval ship construction standards were demonstrated when the *USS Cole* was attacked. If that ship had been built in any other country, she probably would not have survived. Foreign manufacturers, for the most part, do not meet U.S. design and construction standards.

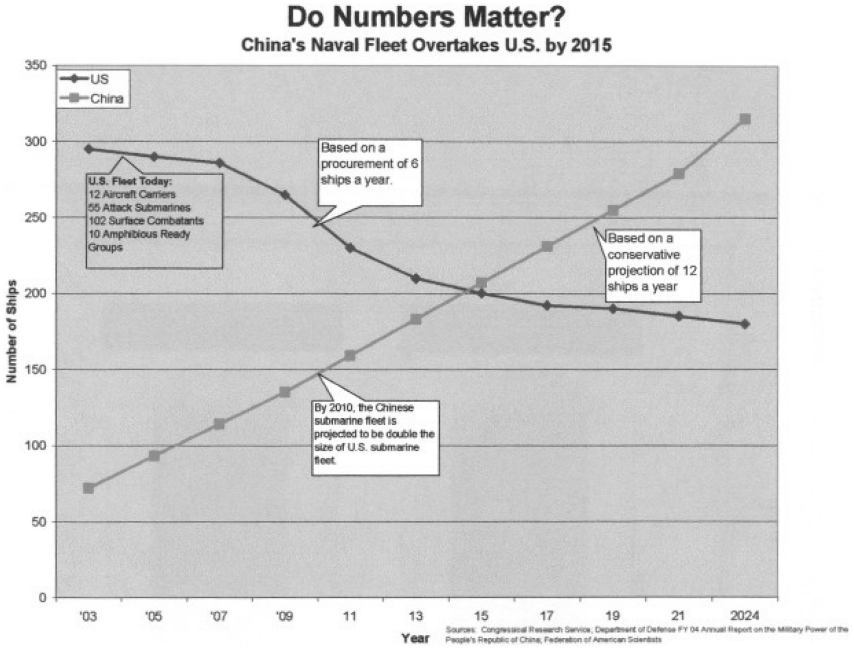
This reliance on U.S. manufactured equipment, however, is dissipating in response to pressure from DoD to open competition to foreign sources and to lower military specifications in an effort to reduce costs. DoD has been urging defense contractors to rely more on commercial off-the-shelf systems rather than systems built to military specifications. This emphasis on contracting with the lowest cost producer is forcing all member companies of the defense shipbuilding industrial base to source more of its material, components, and systems foreign. Historically low production rates for naval ship construction, combined with increased competition from foreign manufacturers is jeopardizing America's skill base and weakening the financial viability of countless specialized U.S. manufactures that make up the defense shipbuilding industrial base.

China's Growing Naval Fleet and Shipbuilding Industry

While the U.S. is allowing our force projection naval fleet to decline, China is investing in building a blue water Navy to challenge the U.S. in the future, according

to defense and intelligence experts. China's naval buildup began with China buying submarines and surface combatants from Russia. Now China, after years of investing in her indigenous shipbuilding industry, is building advanced submarines, surface combatants, and amphibious ships. If the U.S. allows our submarine fleet to shrink to 33 submarines, which is the projection based on the current build to retirement rate, China's submarine fleet will be twice the size of ours by 2010. If China expands her naval fleet by 12 ships a year, China's Navy will surpass that of the United States in 2015. While China's ships are not as capable as those of the U.S., the submarines and surface ships being built by China are advancing quickly in technology and capability. China is building a new class of conventional submarines, the Yuan Class. This class is a follow-on to its Song Class of diesel electric submarines. It also has nuclear submarines bought from Russia. It has begun construction of a new class of destroyers as a follow-on to its LUHAI Class. This new class is believed to match the air defense capability of the DDG–51 class.

The following chart illustrates the direction of the U.S. naval fleet compared with that of China's.



In 1989, China had essentially no shipbuilding industry or marketshare. In a little over a decade China has invested in its shipbuilding industry to become the third largest builder of commercial ships behind South Korea and Japan. Today, China has the capacity to produce 16 million deadweight tons a year and China's commercial shipbuilding marketshare is approaching 25 percent. The China State Shipbuilding Corporation (CSSC) is investing billions in building larger and larger shipyards in China in an effort to become the world's largest shipbuilding country. In June of this year, CSSC announced a $3.6 billion shipyard construction project on Changxing Island. Once completed, the shipyard is expected to have the capacity to produce more than 4.5 million deadweight tons (DWT) a year, making it the largest shipyard in the world.

The United States does not rely exclusively on DWT as a measurement for capacity. However, if you were to compare the number of ships delivered in a year, Hyundai Heavy Industries of South Korea, presently the world's largest shipyard, delivered sixty ships last year. By comparison, based on declining orders from the U.S. Navy, U.S. shipyards delivered an average of two ships per shipyard, though the individual shipyards have the capability and capacity to build many more ships per year.

China is also investing in its shipbuilding supplier base with the objective of having the domestic capability to manufacture all ship systems, components and mate-

rials. Today, China has the capability to manufacture 40% of equipment for ships domestically.

More and more manufacturing of ship components and systems will migrate to China as DoD encourages foreign sourcing in its efforts to find the cheapest source. This has already begun with regard to materials for naval components. The manufacture of entire components and systems will migrate to China in the next several years under current DoD policy with respect to outsourcing.

Conclusion

Decisions made on the Navy's shipbuilding budget this year and over the next few years, will determine the physical capacity and the size of the shipbuilding skilled engineering and production workforce of the United States. If China continues to expand her shipbuilding base and naval fleet, it will take the industry this country has today—at a minimum—to match this security threat. If the industry is reduced further, the U.S. will have to reconstitute the industry if it is to counter the threat from China. Reconstitution of facilities and the skilled workforce, if possible, will be extremely costly and will take a decade.

America should learn from history. Great Britain is a recent case history lesson. The once mighty sea power nation took an extended holiday in naval ship construction, and lost most of her industrial base. Today, Great Britain is trying to rebuild a nuclear submarine, but has lost the engineering know how. We have sent 200 engineers to England to help retrain them in the art of nuclear submarine design and construction. For the first time in 50 years, no new submarine is being designed in the U.S., which threatens our future engineering capability. The U.S., a democratic country and ally of England, has been there to cover England's back defensively. China is a communist country with great ambitions to overtake the U.S. economically and militarily. There will be no one to cover our back when we lose our domestic defense shipbuilding industrial capability and sovereignty.

Recommendations

1. The U.S. security requirement for naval ships far exceeds the fleet of today. The DoD should increase and stabilize naval shipbuilding budgets at $15 to $16 billion a year to provide for the production of 12 multi-mission combatant and logistic support ships a year to counter the rapidly growing Chinese Navy.
2. The DoD and Congress should require that naval ships and their components be manufactured in the United States to ensure the highest quality and to sustain the U.S. shipbuilding industrial base. This action will ensure America's independence in determining its own destiny.

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AMERICAN SHIPBUILDING ASSOCIATION

Membership of the American Shipbuilding Association

Shipyards

Avondale
New Orleans, LA

Bath Iron Works Corporation
Bath, ME

Electric Boat Corporation
Groton, CT
Quonset Point, RI

Ingalls Shipbuilding
Pascagoula, MS

National Steel & Shipbuilding Co.
San Diego, CA

Newport News Shipbuilding
Newport News, VA

Partners

Advanced Structures Corp.
Deer Park, NY

AGM Container Controls, Inc.
Tucson, AZ

Alfa Laval, Inc.
Richmond, VA

ALSTOM Power Conversion, Inc.
Pittsburgh, PA

American Bureau of Shipping
Houston, TX

American Iron & Steel Institute
Washington, DC

American Metal Bearing Co.
Garden Grove, CA

AMSEC
Virginia Beach, VA
San Diego, CA

APEX Steel Corp.
Englewood, NJ

Atlantec Enterprise Solutions
Annapolis, MD

AVEVA Inc.
Wilmington, DE

Baker Sheet Metal Company
Norfolk, VA

BWXT
Lynchburg, VA
Idaho Falls, ID
Mt. Vernon, IN
Barberton, OH

Communications Company, DRS
Wyndmoor, PA

Corrosion Engineering Services
San Diego, CA
Pearl City, HI
Norfolk, VA
Bremerton, WA

Curtiss-Wright Flow Control Corp.
Cheswick, PA

D.G. O'Brien, Inc.
Seabrook, NH

Dresser-Rand
Olean, NY

DRS Technologies
Parsippany, NJ

Electric Power Technologies, Inc., DRS
Hudson, MA

Electronic Systems Inc., DRS
Gaithersburg, MD

EMS Development Corporation
Yaphank, NY

Fairbanks Morse
Beloit, WI

Flo-Tork, Inc.
Orrville, OH

G. E. Marine
Cincinnati, OH
Lynn, MA

General Atomics
San Diego, CA
Tupelo, MS

General Cable Corp.
Highland Heights, KY

Guill Tool & Engineering Co., Inc.
West Warwick, RI

Henschel
Newburyport, MA

IMO Pumps
Monroe, NC
Columbia, KY

Intergraph Corporation
Huntsville, AL

International Paint
Houston, TX
Union, NJ

Jamestown Metal Marine Sales, Inc.
Boca Raton, FL

John J. McMullen Associates
Alexandria, VA

L3 Communications
New York, NY

Laurel Technologies, DRS
Johnstown, PA

Marlo Coil
High Ridge, MO

Marotta Controls, Inc.
Montville, NJ

Nelson Stud Welding, Inc.
Elyria, Ohio

ODI Advanced Technology Systems
Ormond Beach, FL

Oil States Industries
Arlington, TX

Pacific Marine System
South El Monte, CA

PacOrd
San Diego, CA

PCE
San Diego, CA

Portland Valve, Inc.
South Portland, ME

Power & Control Technologies, DRS
Danbury, CT
Milwaukee, WI

Power Paragon
Anaheim, CA

Power Technology Inc.
Fitchburg, MA

Purolator Facet, Inc.
Greensboro, NC

Raytheon Integrated Defense Systems
Tewksbury, MA

Rolls-Royce Naval Marine
Walpole, MA
Pascagoula, MS
Annapolis, MD

Sargent Controls & Aerospace
Tucson, AZ

Sauer Compressors USA, Inc.
Stevensville, MD

The Sherwin-Williams Company
Cleveland, OH

SPD Electrical Systems
Philadelphia, PA

Sperry Marine
Charlottesville, VA

Spiritech, Inc.
Johnstown, PA

Standard Nut & Bolt Co.
Fall River, MA

Survelliance Support Systems., DRS
Largo, FL

Tano/EDI
Metaire, LA

Technical Services, DRS
Chesapeake, VA
San Diego, CA

Training & Control Systems, Inc., DRS
Ft. Walton Beach, FL

Turnbull Enterprises, Inc.
Baltimore, MD

US Joiner
Waynesboro, VA

U.S. Pioneer, Inc.
Tulsa, OK

VACCO Industries
South El Monte, CA

Village Marine
Gardena, CA

Waggaman Crane Services
Waggaman, LA

Warren Pumps
Warren, MA

Westwood Corp.
Tulsa, OK

York International
York, PA

Cochair WESSEL. Dr. Howard.

STATEMENT OF WILLIAM HOWARD
CHAIRMAN, DEFENSE SCIENCE BOARD TASK FORCE
ON HIGH PERFORMANCE MICROCHIP SUPPLY
DEFENSE DEPARTMENT, WASHINGTON, D.C.

Dr. HOWARD. Thank you, Mr. Commissioner. The subject of my discussion this afternoon is a report by the Defense Science Board, and advisory board, the senior advisory board on matters of technology to the Secretary of Defense and to the Under Secretary for Acquisition, Technology and Logistics.

For some time, we have studied the high performance microelectronics situation in this country, the Department's future needs for microelectronics and for the situation with regard to its supply. As you probably know, microelectronics are our defining difference, our force multiplier in military systems and in military operations.

Communication systems, intelligence base and support systems all rely upon complex microelectronics as well as the weapons systems that they support. Many of those components are mission critical. If the component fails, the system fails. If the airplane crashes, in the case of advanced aircraft, the tank is unable to hit its target, a whole lot of people can't communicate with one another.

Early in the life of the integrated circuit business, DoD was an important shaping force. It accounted for about 20 percent of the business in the mid-1960s as a result of the Minuteman program, but today that fraction has dropped to a very small fraction of the total market, about one to two percent.

We have, the Defense Department has long had unique chip needs which it has served by captive production facilities, in defense firms and government agencies, but these have proven difficult and expensive to maintain at acceptable technology levels and most of them have closed as a result of the cost.

As a result, the Defense Department and its contractors rely increasingly upon commercial off-the-shelf components, and standard ICs, called COTS and have reduced their dependency upon application specific ICs or ASICs. And the move to COTS made a significant improvement in our ability to field systems, our ability to get replacements, and reductions in costs.

However, there is a residue of special parts that remains. The study that we conducted basically looks at the DoD's future in microelectronic component acquisition and what the problems are in the light of major restructuring in the industry.

Let me get down to the right portion here. The main cause of our concern is that the industry is undergoing a significant restructuring. When I entered the industry 30 years ago, 40 years ago, the industry was vertically integrated. Each company manufactured its own starting material, manufactured its own manufacturing equipment, did its own design, produced its own circuits, packaged those circuits and sold them, tested and sold them, and as a result, they were completely vertically integrated.

With time, various components have become outsourced. First of all, equipment, next of all, materials, then testing, then packaging, then even in some cases selling because you rely upon representatives and distributors in some cases. The heart of the technology in the business was always taken to be the wafer processing part,

the part that produces the chips that everybody talks about in their computers and in their cars and in many commercial applications.

This part has been held as sort of the core of most companies' semiconductor business, but the cost of building factories for such chips has risen to a level where individual companies can no longer afford that. The cost of leading-edge facility now is of the order of $3.5 billion at the 90-nanometer generation of technology and as a result there has arisen an industry called the foundry industry which takes business from a collection of companies, produces chips and sends them back for packaging, testing and so on.

The difficulty is that the bulk of this foundry business is located outside the United States. The two largest companies in the business, TSMC and UMC, are located in Taiwan. In third place is Charter Semiconductor in Singapore and more and more of this business is actually moving out of Taiwan and into China.

So this structure, restructuring is a good thing for industry because it reduces the capital intensity of the industry. On the other hand, from a national security standpoint, where chips are mission critical and involve sensitive information, sensitive designs, it is not in the best interest, so we have a divergence of the industry's tactics and technology and manufacturing model and what is necessary for the industry.

The fraction of what is called foundry business in this country has now risen to about 25 percent, and that represents almost entirely the leading edge. There are only three companies left in this country who practice leading edge technology: IBM, Intel and Texas Instruments, and only one of those will do business with the U.S. Government because of the issues of security, the issues of dealing with the Federal Acquisition Regulations and a few other things.

Major problem. As a result, we are dependent on a sole source within the United States or making these sensitive products offshore, which means that they are vulnerable to a number of problems including the same kinds of things that you see in software, Trojan horses, worms, viruses and so on. And also that we're vulnerable to changes in manufacturing process that compromised the reliability of the circuits.

That said, our panel went to a number of recommendations. The first recommendation we have is that the U.S. must be as productive a place to put high tech manufacturing facilities as any other place in the world, productive in the sense that our cost of capital is equal to the cost of capital anyplace else for this particular industry.

The reason that this business has moved offshore used to be labor costs. It's no longer labor costs. The critical issue is cost of capital and other issues associated with locating plants in the United States.

The second issue is that the Department of Defense does not have a good idea of what its future semiconductor and integrated circuits needs are. It has a general idea that it's dependent upon these things, but in fact contractors make most of the systems and subsystems these days and the Department has not been able to gather a sufficient vision to be able to plan for the future.

Our third recommendation is that the Department needs to size the demand that it has for circuits in the future. We know a certain number of those, but we have by no means done a complete assessment of what our special technology/special applications needs are for the future, and finally the Department needs to put together an acquisition program which takes into account the need for secure trusted and assured sources of integrated circuits.

In addition to that, the Department needs to begin to look at working with the industry to redefine the manufacturing model for integrated circuits. The industry has developed its manufacturing model based on the production of very high volumes of commodity products: microprocessors, memories, a whole variety of other standards kinds of products. But as a result, it's become prohibitively expensive to make application-specific integrated circuits.

The cost of design on application-specific integrated circuit at the leading edge today is about $26 million, making it prohibitively expensive to think about quantities that the Defense Department will use. That requires a change in the manufacturing model. It requires a change in the manufacturing equipment.

Next, we urge that the Department look at controlling certain sensitive manufacturing equipment, specifically the design tools where the U.S. is still in the leadership position.

Our next recommendation is that military systems should use programmable software and hardware both, specifically hardware—microprocessors, field programmable rays and other circuits, digital signal processors—to simplify the design of systems, putting as much in the software as possible and using commodity products as much as possible.

And finally that the Department look very carefully at its unique technologies, unique technologies such as radiation-hardened ICs, special sensors, power and high frequency electronics, and countertamper technologies in its development of defense integrated circuit technologies.

This is a very brief summary of a much longer report. I regret that there must be a Trojan horse somewhere in the computer system and I was unable to display the slides that go along with it, but that is the essence of our report.

Thank you very much for your time and attention.

DSB Task Force on High Performance Microchip Supply

Trusted Foundry Needs of the Department of Defense

DoD and High Performance Microelectronics

- DoD has become dependent upon high performance microelectronics as its “force multiplier” –
  - Modern weapons, communications, intelligence, space and support systems all rely on complex microelectronics components to handle complex computational and communications tasks
  - Some microelectronics components are “mission-critical” and/or contain classified design elements. Such chips are susceptible to subversion by adversaries. Additionally, component lifetimes depend on subtle process parameters
  - Some system-critical chips are the hardest to obtain. They require leading edge processes, quick response and low manufacturing volume over long system lives.
- Early in the life of the IC industry DoD was an important shaping force for products and processes.
  - Now the DoD share of market is small (1-2%)
  - Its influence over commercial manufacturers is very diminished.

DoD Microelectronics Component Acquisition

- DoD has long had unique chip needs – served by captive production facilities in defense firms and in government agencies.
  - These have proven difficult and expensive to maintain at an acceptable technology level. Most have closed
- DoD and its contractors have sought to reduce their dependence on custom ICs (ASICs) by relying, as much as possible, on Commercial Off-The-Shelf components and programmable logic devices
  - The move to COTS has greatly improved and sped up system design and lowered cost, however long system life still poses replacement part problems
  - A residue remains of special functions and technologies that require unique fabrication.
- This study examines DoD's future microelectronic component acquisition challenges in the light of ongoing industry structure and technology changes

The microelectronics industry, supplier of hardware capability that underlies much of America's modern military leadership technology, is well into a profound restructuring. One unintended result of this otherwise sound industry change is the relocation of critical microelectronics manufacturing capabilities from the United States to countries with lower cost capital and operating environments. From a U.S. national security view, the potential effects of this restructuring are so perverse and far reaching and have such opportunities for mischief that, had the United States not significantly contributed to this migration, it would have been considered a major triumph of an adversary nation's strategy to undermine U.S. military capabilities.

This threat led DEPSECDEF Wolfowitz to write a memo calling for a Defenses Integrated Circuit Strategy

DEPUTY SECRETARY OF DEFENSE
1010 DEFENSE PENTAGON
WASHINGTON, DC 20301-1010

OCT 10 2003

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARIES OF DEFENSE
ASSISTANT SECRETARIES OF DEFENSE
GENERAL COUNSEL OF THE DEPARTMENT OF DEFENSE
DIRECTOR, OPERATIONAL TEST AND EVALUATION
INSPECTOR GENERAL OF THE DEPARTMENT OF DEFENSE
ASSISTANTS TO THE SECRETARY OF DEFENSE
DIRECTOR, ADMINISTRATION AND MANAGEMENT
DIRECTOR, PROGRAM ANALYSIS AND EVALUATION
DIRECTOR, NET ASSESSMENT
DIRECTOR, FORCE TRANSFORMATION
DIRECTORS OF DEFENSE AGENCIES
DIRECTORS OF THE DOD FIELD ACTIVITIES

SUBJECT: Defense Trusted Integrated Circuit Strategy

The country needs a defense industrial base that includes leading edge, trusted commercial suppliers for critical integrated circuits used in sensitive defense weapons, intelligence and communication systems. The purpose of this memo is to establish a strategy to ensure that such suppliers exist. The strategy has five components:

a. Facilities Identification: Identify within the integrated circuit (IC) defense industrial base those facilities that could qualify as "trusted sources" for application specific integrated circuits (ASICs) based upon special facility clearances or other government agency technical certification. This survey will identify potential sources for the production of ASICs and will assess whether sufficient capacity currently exists to supply the defense and intelligence communities requirements on a competitive basis.

b. Product Identification: Identify the products that the above facilities can produce.

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c. Near term solutions: Using data identified in (a) and (b) above, identify and adjust acquisition strategies to maximize competitive opportunities while preserving domestic capability.

d. Research Initiatives: (1) Fund research to design and test procedures to assure security concerns have been met. (2) Fund research into next generation IC design for specialized defense applications.

e. Healthy Commercial IC Industry: We should ensure the economic viability of domestic IC sources. The health of the defense IC supplier community depends on the health of the larger commercial IC base. One important enabler of the larger commercial base is balanced policies that do not unnecessarily restrict US sources from the global economic market. Therefore, the DoD will support policies that provide a level playing field internationally for the procurement of commercial products.

Each part of the strategy will require detailed implementation plans. Because of near-term urgency, the Intelligence Community and DoD, using the NSA Information Assurance Directorate as Executive Agent, are taking actions to preserve a current domestic supply source.

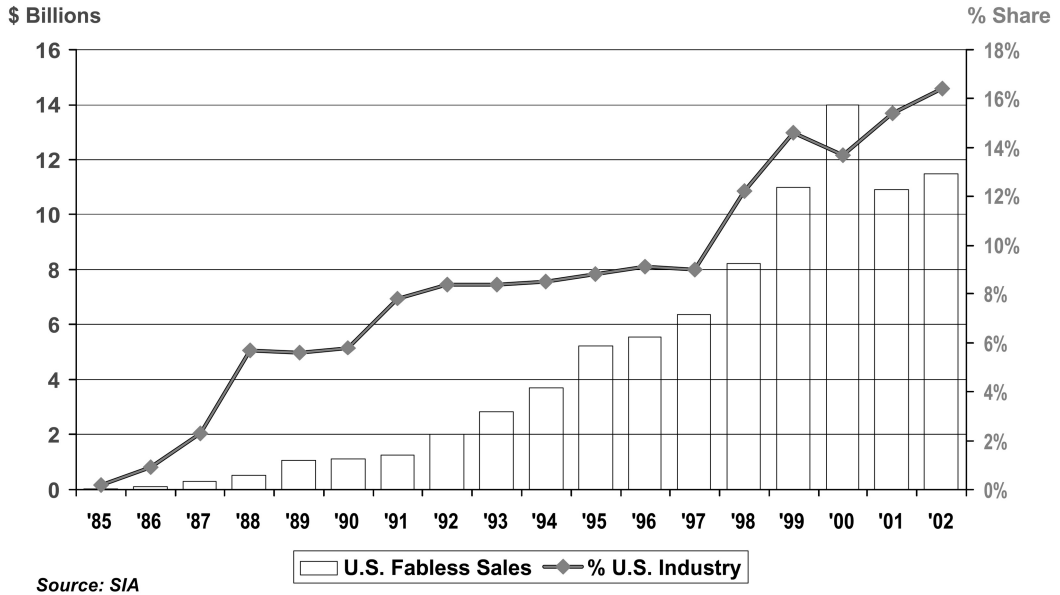
Mr. Michael W. Wynne, Acting Under Secretary of Defense (Acquisition, Technology and Logistics), will oversee implementation of the strategy. He will coordinate responses to any inquiries about integrated circuits or semiconductors. Miss Suzanne Patrick, Deputy Under Secretary of Defense for Industrial Policy; Dr. Charles Holland, Deputy Under Secretary of Defense for Science and Technology; and Mr Robert Lentz, Director, Information Assurance, Office of the Assistant Secretary of Defense for Networks and Information Integration will coordinate implementation of the strategy. Their action officer is Lieutenant Colonel Chris Warack, USAF. You may reach him by telephone at (703) 602-4325 or by electronic mail at christopher.warack@osd.mil.

Paul Wolfowitz

Several Major Changes Are Well Underway In The Semiconductor Industry:

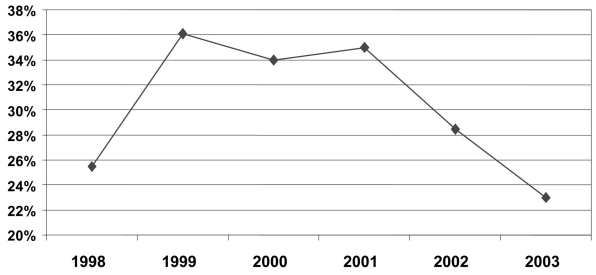
- The classical vertically integrated company is rapidly being replaced by hollow “fabless” firms that contract out manufacturing
  - Driven by dramatic increases in investment required to manufacture advanced technologies and market demand for much better returns on capital investment

The fabless/foundry business model has grown to 16% of the U.S. chip industry. The trend is strongest in the leading process technology portion of the industry



Source: SIA

U.S. industry's share of capital expenditures falling in leading edge semiconductor manufacturing capacity.



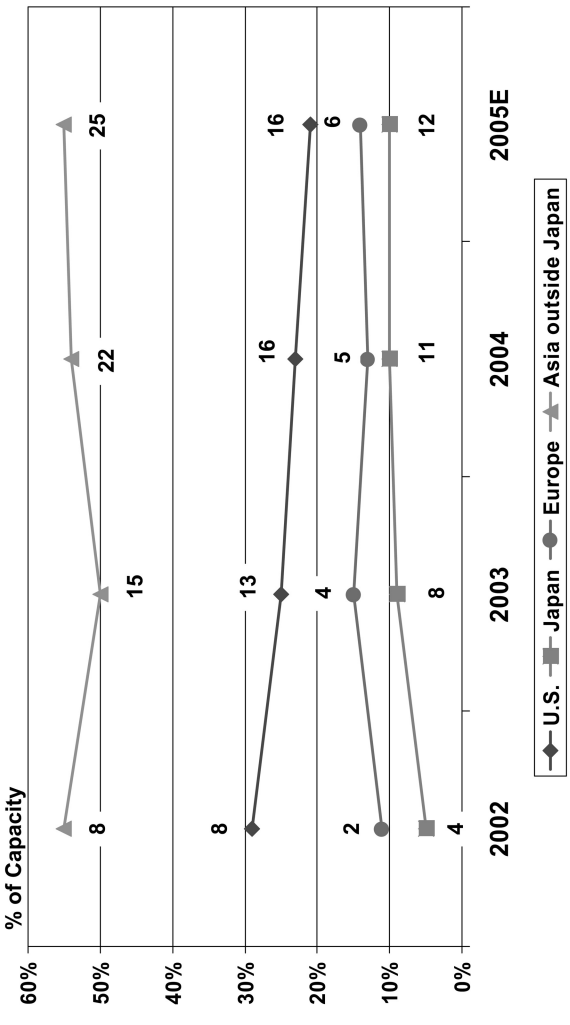
Leading Edge	< 0.4µ	< 0.3µ	< 0.3µ	< 0.2µ	< 0.2µ	<0.16

Source: SICAS/SIA

Early indications are that this trend continued downward in 2004 – this is a structural shift, not a result of short-term business fluctuations

Several Major Changes Are Well Underway In The Semiconductor Industry:

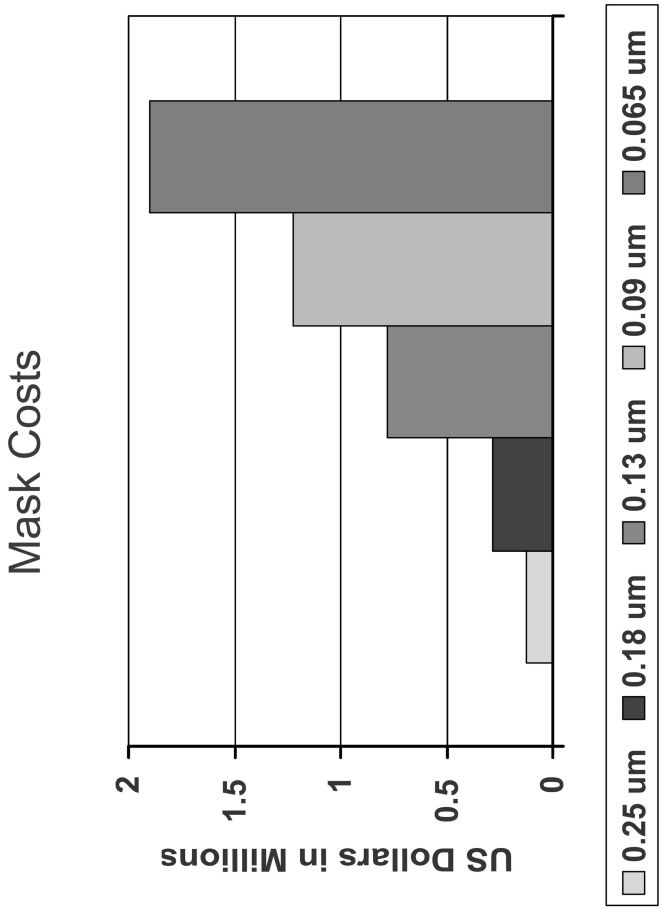
- The classical vertically integrated company is rapidly being replaced by hollow "fabless" firms that contract out manufacturing
  - Driven by dramatic increases in investment required to manufacture advanced technologies and market demand for much better returns on capital investment
- Expensive manufacturing capacity is moving abroad, mostly to Taiwan, China and Singapore
  - Packaging and testing already well-established
  - Design is beginning to follow
  - Driven by national decisions that native semiconductor industries are strategically important, warranting strong capital investment incentives



Note: Number of fabs is cumulative. These figures include R&D fabs; which operate at a much lower capacity than a production fab.
Source: International SEMATECH

Several Major Changes Are Well Underway In The Semiconductor Industry:

- The classical vertically integrated company is rapidly being replaced by hollow "fabless" firms that contract out manufacturing
  - Driven by dramatic increases in investment required to manufacture advanced technologies and market demand for much better returns on capital investment
- Expensive manufacturing capacity is moving abroad, mostly to Taiwan, China and Singapore
  - Packaging and testing already well-established
  - Design is beginning to follow
  - Driven by national decisions that native semiconductor industries are strategically important, warranting strong capital investment incentives
- Low manufacturing volume, advanced technology "ASICs" are becoming prohibitively expensive on a per unit basis
  - Total design and prototyping costs are typically $26M
  - The mask set, alone is more than $1M


Mask Costs
US Dollars in Millions
2
1.5
1
0.5
0
0.25 um
0.18 um
0.13 um
0.09 um
0.065 um

Several Major Changes Are Well Underway In The Semiconductor Industry:

- The classical vertically integrated company is rapidly being replaced by hollow "fabless" firms that contract out manufacturing
  - Driven by dramatic increases in investment required by advanced technologies and market demand for much better returns on capital investment
- Expensive manufacturing capacity is moving abroad, mostly to Taiwan, China and Singapore
  - Packaging and testing already well-established
  - Design is beginning to follow
  - Driven by national decisions that native semiconductor industries are strategically important, warranting strong capital investment incentives
- Low manufacturing volume, advanced technology "ASICs" are becoming prohibitively expensive on a per unit basis
  - The mask set, alone is ~$1M
- The rapid rate of technology change quickly makes chip designs obsolete

These Changes are not in the best interests of DoD:

- DoD requires **trusted** and **assured** sources of IC components:
  - Trusted to ensure protection of classified designs, integrity of mission-critical components and long operating life
  - Assured to guarantee access to special military technologies, quick response for time-critical designs, parts availability for the life of the system

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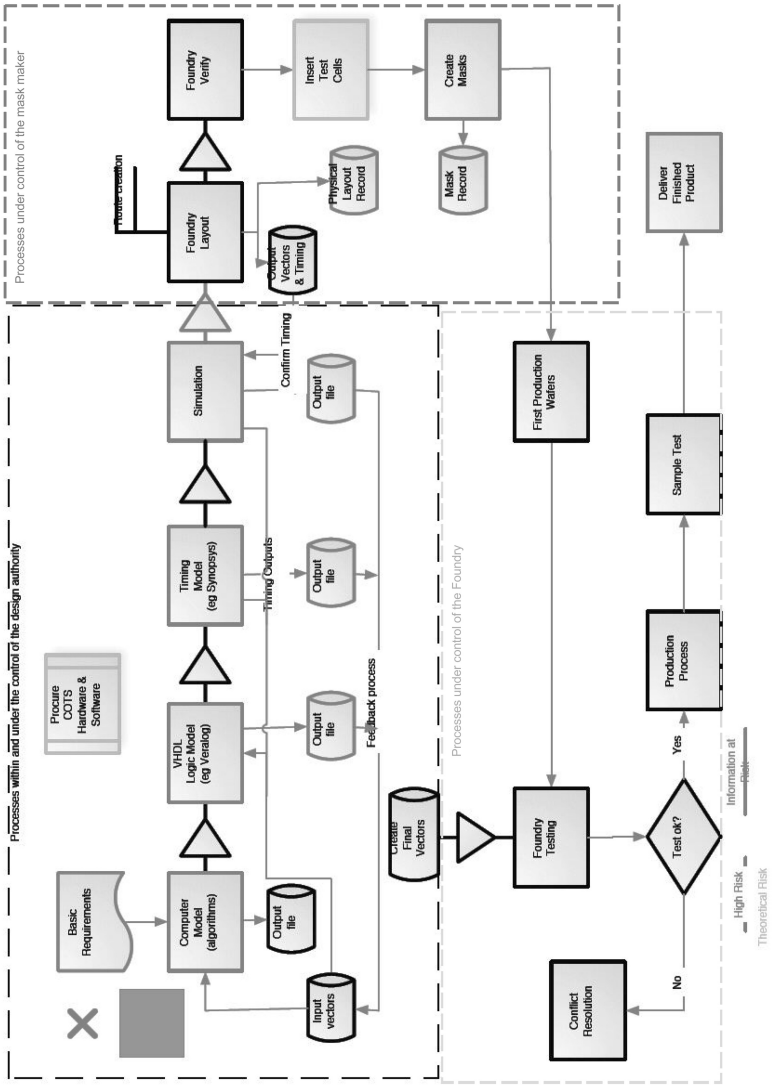
  - Trusted to ensure protection of classified designs, integrity of mission-critical components and long operating life
  - Assured to guarantee access to special military technologies, quick response for time-critical designs, parts availability for the life of the system
- **KEY POINT: TRUST CANNOT BE ADDED TO ICs AFTER FABRICATION (i.e., modifications to designs cannot reliably be detected)**
  - Electrical or imaging testing or reverse engineering are neither practical nor economically feasible.
  - Applies to both ASICs and COTS


Processes under control of the mask maker
Foundry Verify
Insert Test Cells
Create Masks
Foundry Layout
Physical Layout Record
Mask Record
Output Vectors & Timing
Deliver Finished Product
Processes within and under the control of the design authority
Simulation
Confirm Timing
Output file
First Production Wafers
Timing Model (eg Synopsys)
Timing Outputs
Output file
Sample Test
Procure COTS Hardware & Software
VHDL Logic Model (eg Veralog)
Output file
Feedback process
Production Process
Processes under control of the Foundry
Basic Requirements
Computer Model (algorithms)
Output file
Create Final Vectors
Foundry Testing
Test ok?
Yes
Information at Risk
High Risk
Theoretical Risk
Input vectors
Conflict Resolution
No

DoD Has Responded To These Challenges By:

- Past reliance on the US IC industry and captive foundries for supplies of sensitive components
  - US Industry down to three on shore, leading edge IC logic fabricators (IBM, Intel, possibly TI) only one of which will accept foundry business
  - NSA, Sandia and defense contractor facilities are too costly to keep up to the state-of-the-art
- Establishing a Radiation-Hardened IC program at two US defense firms (BAE and Honeywell)
- Establishing a "Trusted Foundry" program with three tiers:
  - Tier I: leading edge – contract with IBM for take-or-pay services
  - Expanding to Tier II and III where there is more competition
- There are serious risks inherent in these ad hoc efforts

The Task Force's Conclusion:

- The Department of Defense and its suppliers face a major integrated circuit supply dilemma that threatens the security and integrity of classified and sensitive circuit design information, the superiority and correct functioning of electronic systems, system reliability, and the continued supply of long-life system and special technology components.
  - All the tools of the software "hacker" apply to IC designs and more: Viruses, Trojan Horses, and Worms in addition to process compromises
  - Software and hardware hacking threats taken together are a formidable security challenge
- The solution to this dilemma has a direct impact on the successful application of microelectronics to defense systems

Findings and Recommendations - 1

Industry Environment

- F: As indicated in the DEPSECDEF memo, the health of the semiconductor industry is a matter of national security – R&D and production go hand-in-hand; loss of one leads to loss of the other, with major military force multiplier consequences. Without a sizable production base, US component technology will lag.
- R: DoD, using the power and influence of the SECDEF, must take a strong advocacy position within the US government for polices and actions that ensure the US offers as good an environment for semiconductor investment as anywhere else in the world

Defense Vision

- F: DoD and its prime suppliers have no comprehensive picture of their future microelectronics needs on which to base plans for supply trust, assurance and special technologies throughout the stages of system life
- R: SECDEF and the USD(ATL) should formulate a forecast-based vision on which to base transformation of the microelectronics supply environment

Size the Problem

- F: DoD has no comprehensive estimate of the size of its microelectronics needs, but the defense fraction of the world IC market is now 1 – 2%; can identify 50-60 DoD ASICs / yr, but no estimate of supplier mission-critical needs.
- R: DoD should continue DDR&E and IDA IC consumption studies and expand them to identify classes, technologies and volumes of ICs that require trusted and assured supply

Findings and Recommendations - 2

DoD Acquisition Strategy

- F: DoD's microelectronics directed acquisition efforts have been largely ad hoc – reactions to problems as they have arisen (RHOC, Trusted Foundry programs). Throughout the recent history of microelectronics, DoD has been, for the most part, a "customer of last resort." Industry competition has now dwindled to the point where there is no longer a diverse supply base of IC suppliers controlled and manufacturing in the US.
- R: DoD must been seen as a desirable customer in the future. DoD (USD(ATL), USD(IP)), working with industry, must determine how best to establish a meaningful government-industry partnership to assure DoD and its system suppliers meet their microelectronics supply needs

Custom IC Design and Production Models and Technology

- F: DoD will continue to have an irreducible need for complex, high performance, custom ICs. The current industry emphasis on mass production has made ASICs using leading edge technology prohibitive. A similar, unfulfilled industry need is now developing. Fifteen years ago DARPA had a program, MMST, addressing this issue, but with different goals.
- R: DDR&E should take another look at the economics of manufacturing limited production volume ASICs with the goal of mounting an effort, like SEMATECH, to meet the need for leading edge technology, low production volume critical parts..

SME Export Controls

- F: The current global system of semiconductor export controls is inconsistent and uncertain
- R: The US, at DoD's urging, should strengthen the Wassenaar Arrangement with bilateral agreements with major SME supplier nations and Taiwan to ensure that SME exports to potential adversary nations are suitably regulated. DoC should gather information on foreign availability of critical SME to aid in export license decision-making

Findings and Recommendations - 3

Programmable Hardware and Software

- F: Many custom, modest performance digital IC functions today are constructed using programmable logic chips (structured ASICs, FPGAs, processors and DPSs) together with memory (DRAMs, SRAMs and ROMs), storing both program instructions and circuit configurations. The logic chips have far more intricate designs and are the most critical and the hardest to verify. US companies still lead in the design of programmable logic chips, however continued US leadership in this area cannot be taken for granted.
- R: To promote continued US strength in this and other IC technologies, DDR&E should:
  - Partner with industry and other US government agencies (e.g., NSF and DHS) to support continued university research to ensure an adequate supply of skilled scientists and engineers in the field
  - Foster interchange of the best counter-tamper practices to assure integrity of government and commercial design through courseware and industry information programs
  - Institute a targeted program in the area of firmware integrity to rapidly develop, disseminate, and encourage adoption of improvements in this trust-related aspect of programmable designs, and
  - In conjunction with the above, encourage research in “Design for Trust Evaluation”

DoD-Unique Technologies

- F: Defense systems, by their nature, will continue to require special technologies for which there is no wide commercial demand. These include radiation hardening, low and high power electronics, and counter-tamper techniques. R&D to meet these needs is supported mainly through DoD mission agencies such as DTRA and NSA.
- R: DDR&E should continue special technology R&D and, in addition,
  - Reduce controls on international trade in radiation-tolerant “standard” designs that discourage commercial firms from evaluating their hardness.
  - Increase efforts to develop tamper protection technology, and
  - Develop design and production terchnologies to disguise the true function of sensitive ICs

Findings and Recommendations - 4

Adversarial Clandestine Operational Opportunities

- F: DoD and its suppliers will continue to depend on advanced technologies progressively only available offshore. Opportunities for adversaries to clandestinely manipulate designs and technology used in US critical applications are enormous and increasing at every stage of an IC product's life. Risk management is essential, since risk avoidance will be prohibitively costly.
- R: The DDR&E, working together with the intelligence community, should assemble an accurate characterization and assessment of adversaries' "dirty tricks" to facilitate developing an effective US counter-tamper strategy. They should further develop risk mitigating technical approaches to support the risk management process. DDR&E should take the lead in defining requirements and making investments to achieve security breakthroughs.

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION,
TECHNOLOGY
AND LOGISTICS

DEC 18 2003

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Terms of Reference -- Defense Science Board Task Force on High Performance Microchip Supply

You are requested to form a Defense Science Board Task Force on High Performance Microchip Supply.

The migration of semiconductor manufacturing and design capability to foreign countries imposes significant challenges upon the United States. The movement of manufacturing capability may leave the Department of Defense without an assured supply or access to emerging new designs. Failure to assure supplies may lead to future critical parts shortages at inopportune times, an inability to access new microchip designs in a timely manner during the design of new systems, or compromise sensitive national security information embedded in chip designs. In addition, the offshore movement of manufacturing and design capability could lead to inability to assure design function. The failure to assure design function could result in the intentional insertion of unknown vulnerabilities into vital pieces of equipment and result in the exploitation by a foreign government. A careful analysis of the implications associated with the movement to offshore manufacturing and design facilities is warranted.

The Task Force should assess the implications of the movement of manufacturing capability and design for three scenarios. As a minimum, the Department of Defense needs to address their ability to obtain radiation hardened microchips, the ability to produce limited quantities of special purpose microchips in a timely and secure manner, and the ability to produce microchips in a timely manner to meet emerging needs.

While investigating these scenarios the Task Force should address the following:

a. What are the root causes associated with the migration of the manufacturing capability of high performance semiconductors? Are there policies or technology investments that DoD, either alone or in conjunction with other US government agencies, can pursue which will influence the migration of manufacturing to foreign shores?

b. Do alternatives to the creation of trusted foundries based on US territory exist? Is testing a viable alternative and if so, what level of assurance will testing provide to guarantee that only intended functions are built into the microchip?

c. Are there alternative manufacturing techniques which will allow overseas fabrication of the microchips and subsequent interconnect development in the US? Can field programmable gate array (FPGA) microchips provide suitable performance capabilities for DoD's specialized needs?

d. Finally, are there future technologies which the US may invest in to replace the current microchip technology?

The Study will be co-sponsored by me as the Acting Under Secretary of Defense (Acquisition, Technology, and Logistics), the Director, Defense Research and Engineering, the Deputy Under Secretary of Defense (Industrial Policy), and the Assistant Secretary of Defense (Networks and Information Integration). Dr. William Howard will serve as the Task Force chairman. Dr. Chuck Byvik will serve as Executive Secretary and LTC Scott Dolgoff, USA, will serve as the Defense Science Board Secretariat representative.

The Task Force will operate in accordance with the provisions of P.L. 92-463, the "Federal Advisory Committee Act," and DoD Directive 5105.4, the "DoD Federal Advisory Committee Management Program." It is not anticipated that this Task Force will need to go into any "particular matters" within the meaning of Section 208 of Title 18, United States Code, nor will it cause any member to be placed in the position of acting as a procurement official.

Michael W. Wynne
Acting

Task Force Members

Howard	William	Dr.	**Chairman**	Consultant
Dolgoff	Scott	LTC	**DSB Secretariat**	DSB OUSD(AT&L)
Byvik	Chuck	Dr.	**Executive Secretary**	USD(AT&L)

Members

Bandy	Bill	Mr.	Member	Matrics, Inc.
Betza	Steven	Mr.	Member	Lockheed Martin
Fisher	Christine	Ms.	Member	ODSD Industrial Policy
Gosler	Jim	Mr.	Member	Sandia National Laboratories
Hart	Tom	Mr.	Member	Quicklogic Corporation
Hartwick	Thomas	Dr.	Member	Consultant
Howell	Thomas	Mr.	Member	Dewey Ballantine
Marshall	Travis	Mr.	Member	Consultant
Tennenhouse	David	Dr.	Member	Intel Corporation
Van Tassel	James	Dr.	Member	Consultant
Wormser	Owen	Mr.	Member	C3I

Government Advisors

Borsuk	Gerald	Dr.	Government Advisor	NRL
Cerny	Charles	Dr.	Government Advisor	AFRL
Clark, USAF	Anne	Maj	Government Advisor	DTRA
Emily	Dave	Mr.	Government Advisor	NAVSEA, Crane Division
Hannah	Barry	Dr.	Government Advisor	Navy Strategic Systems
Jones	Robert	Mr.	Government Advisor	Space and Sensor Technology
Keogh	Joe	Mr.	Government Advisor	U.S. Government
Kosinki	John	Dr.	Government Advisor	Intel & Info Warfare Center
Price	Ray	Mr.	Government Advisor	NSA
Ridgley	Richard	Mr.	Government Advisor	OGA
Thompson	Mark	Mr.	Government Advisor	CIA
VanDyk	Steven	Mr.	Government Advisor	
Warach	Chris	LtCol	Government Advisor	OSUSD(IP)
Zimmerman	John	CDR	Government Advisor	ODUSD(IP)
Zolper	John	Dr.	Government Advisor	DARPA

Maniaci	Joe	Mr.	Support	SAI

Panel V: Discussion, Questions and Answers

Cochair WESSEL. Thank you, and again we apologize for the brevity of time. We know that all three panelists' knowledge of the issues is extensive, and we hope to benefit from it in Q&A as well as in the long term.

Commissioner Reinsch.

Cochair REINSCH. Thank you. Yes, thank you all for excellent presentations. Dr. Howard, I had the opportunity to see your charts and I appreciate your making them available to us in hard copy. Maybe we can get them electronically at some future point if that's okay with you.

First, a question for Dr. Howard. Your report notes the important role of university and independent labs in major technological shifts. Advanced semiconductor manufacturing depends on a close link to strong R&D capabilities. Do you think the Defense Department is investing enough at U.S. universities in basic research related to the semiconductor industry?

Dr. HOWARD. The Department's investment in what is called 6.1, which is basic research technology, has fallen dramatically since about 1985. It's fallen for several reasons. One is that there has been a disassembly of many of the long-term research capabilities in the services and, secondly, DARPA has focused more on specific defense needs and less on basic technology.

There have been good reasons for doing this because there were important problems that the department faced, but we now need to go and be sure that the universities and the independent laboratories are in sufficiently good shape that they can continue to contribute to this business the way they have in the past.

Cochair REINSCH. Do you think the Defense Department has figured that out and has a plan to do that?

Dr. HOWARD. Saying that the Defense Department feels one way or the other is like saying that Congress feels one way or the other. There are certainly many people who have figured this out. There are a few people who are still learning it.

Cochair REINSCH. Well, I hope the former group is better placed than the latter group.

Second, also, Dr. Howard, each time I review the report or hear the presentation, I can't help but come away with the view, and I've raised this with you previously, that an answer to a lot of these problems at the end of the day is inevitably going to be some sort of government-owned or government-subsidized facility, particularly if you want trust and assurance in your product, and you want to be able to observe or control, if you will, every step of the production process.

It seems to me that automatically leads you to some kind of government-owned facility. Am I wrong about that?

Dr. HOWARD. There are several possible answers, of which that is one. A government-owned facility would be extremely expensive and would be very difficult to maintain at the leading edge of technology, not only because of the investment involved, but because of the ability to attract the right kinds of people.

The government doesn't issue stock options and things like that which are frequently incentives to go to work for high technology firms. I think a better answer would be a partnership between a

company or companies and the government to maintain a factory, which would partly serve the needs of the government and also have the discipline of the commercial marketplace to maintain itself at the cutting edge of both cost and technology.

The other possibility, which is the one that we have specifically outlined in this report, is to develop a manufacturing model that is considerably less expensive for products that run in low volumes and low numbers of parts.

The technology the industry uses produces very low cost parts for hundreds of millions of units. It unfortunately doesn't do well at all if you want a thousand or 10,000 of them because the fixed costs are so high.

We think there are ways to get a significant amount of those fixed costs out and that that technology can be developed in a reasonable period of time. One needs to leave several options open. The trusted foundry program that the department has developed with IBM, in fact, is a partnership between IBM and the government to be able to manufacture a certain number of leading edge application-specific ICs per year.

There are risks in that because we are dependent upon a sole source. There are risks in it having to do with the ability of IBM to keep up with the leading edge of technology. These are ineffable risks, hard to quantify, but I think one needs to pursue several courses of action in this—redefine the manufacturing model, look at a facility capable of making these special circuits that the government needs and probably in connection with the commercial firm or firms.

Cochair REINSCH. Thank you. Dr. Lewis, I've run out of time so I won't ask the question.

Cochair WESSEL. Please. Go ahead for just a minute or so.

Cochair REINSCH. Well, just one question. You have it in your written testimony, but you apparently didn't have time to get it in your oral testimony. Could you just say a few words for the benefit of the Commissioners about visas, business travel, student travel and the role they have on innovation and the other problems that you talked about?

Dr. LEWIS. Certainly. One of the areas of strength for the U.S. compared to other countries is the strength of its research universities, and preserving these research universities as leaders in the world will be a key for continued economic and military strength in the United States.

Foreign students contribute to this. They contributed in two ways. First, they usually paid full fare and very often you had a case where a foreign government was subsidizing U.S. research. I think that's a good outcome.

Second, they populated the programs and contributed their efforts to U.S. research programs. In the past, they were more likely to stay here. That's declining, but the first two factors remain important for keeping our universities strong, and to the extent that our visa programs undercut this, it's damaging to our technological leadership.

Cochair REINSCH. Thank you. Thank you, Mr. Chairman.

Cochair WESSEL. Commissioner Becker.

Commissioner BECKER. Thank you, Mr. Chairman, and I want to thank our participants here although I'm going to make my comments directed at the testimony and the industry that Ms. Praeger represents.

Everything that's listed in here is those are Navy yards; aren't they?

Ms. PRAEGER. Predominantly, sir, yes. We do have Avondale and NSSCO do some commercial work.

Commissioner BECKER. Could you tell me roughly how many American flags are turned out on other than naval ships a year in the United States?

Ms. PRAEGER. I can't speak to the American flag issue. I can speak in terms of the actual construction. All of the capital ships for the Navy are U.S. built. However, we're facing a problem with an auxiliary ship issue. It's been going on for a while and legislation has been offered this year. It was offered last year, and it's been reoffered this year, to limit the leasing of foreign-built ships by the Department of Defense.

Presently, DoD is in engaging in a practice, and this goes to the circumvention and weakening of the U.S. defense acquisition laws requiring that U.S. naval ships, anything for the branches of the military be built in this country.

Commissioner BECKER. Excuse me for interrupting. Right now, the United States leases foreign ships for their own use.

Ms. PRAEGER. For their own use and the leases are for 59 months, and I won't go into the details as to why they've structured it that way. But they're leasing some of these vessels for upwards of ten years. Most of these vessels are South Korean built and they are commercial ships that have reached the end of their commercial life or have already realized their capital investment, and they are being leased to the United States government for auxiliary sealift needs.

Commissioner BECKER. The reason I'm asking this is the Kuwait war, the first Iraqi war, the United States had virtually no way to transport the troops and the supplies to Kuwait. In that area, we were defenseless.

We called a war and didn't have any way of getting there. We had to beg, borrow and steal flags from other countries, some of them friendly, some of them not friendly, everything that we could get together in order to deliver; is that not correct?

Ms. PRAEGER. That's correct, sir.

Commissioner BECKER. So the reason I'm raising this is I think this is critical for what we're talking about, that the United States has to have the ability to deliver what it starts. I wanted to point that out. We're not producing the ships that would go under commercial flags or United States flags for this purpose, and this is something I believe that we should look at.

Ms. PRAEGER. Yes, sir, and that's what I'm speaking to in terms of the leasing and the legislation that's been offered is to limit it to no longer than two years for a foreign-built ship. It's to encourage domestic production.

The Department of Defense, by engaging in long-term leases of foreign built ships, is showing that they need these vessels. The argument comes back to being don't circumvent acquisition laws by

finding a loophole. If you need the vessels build them here, keep your industrial base viable, and keep your skill places in set.

Commissioner BECKER. But we're really not doing that?

Ms. PRAEGER. No, we're not, sir.

Commissioner BECKER. The other point I wanted to raise, and you've touched on this lightly, is the skill level that's involved in the six Navy yards where we produce nuclear submarines, where we produce nuclear aircraft carriers.

Incidentally, I believe I'm correct that Newport News is the only yard that produces the nuclear aircraft carrier.

Ms. PRAEGER. Yes, sir.

Commissioner BECKER. I'm going to give you some figures and I'd like your comment. Newport News was in danger of closing down. It takes congressional action in order, obviously in order to start a carrier or nuclear submarine. If that action hasn't been completed there on the thing, the workers are sitting there with nothing to do, and it was in danger of closing down.

The estimates that were given back to us by the Navy at the time are that if a yard closed down and the workers were dissipated throughout the United States or wherever in search of employment, gone from the area, what have you, that it would take 15 years to rebuild that skill level to build the nuke submarines and the carriers.

Would you have a comment on that?

Ms. PRAEGER. That's an excellent point, sir. It's the danger that we are concerned with every single day and the fewer ships you build, the fewer people you can keep employed. The fluctuations within budgets and year to year and the shipyards not knowing how many workers they need to keep and if they're going to have a surge that they need to hire back, your point is well taken, that these are very highly skilled, both engineers and production workers, and it takes years to train to the level to be able to build naval ships.

These workers, for example, a highly skilled pipefitter, if he's not going to know if he's going to have a job from year to year based upon fluctuations and the production workforce and production workload, he's probably going to the private sector to another industry to find something with more stability.

So then the shipyards are placed in dilemma, do we try to entice him back with the uncertainty that he may not have to go through the same situation of finding other employment in awhile, or do we find someone new, train them up and then again face the dilemma of the fluctuation.

That's part of what the concern is with the industry, is we don't have the stability and with the Navy building fewer and fewer ships, it becomes difficult to retain and ensure that you're going to have that workforce needed and not be in a position of not having the skills when a dire situation arise where you're going to have to rebuild.

Commissioner BECKER. I see our time is up, but I'd like to make a summation and see if this is correct; that it's essential that the Navy planners, the Department of Defense, get some kind of an accurate time schedule and work with the shipyards in order to see

that there is a constant flow to be able to meet the demand. Is that fair?

Ms. PRAEGER. That's exactly right, sir. It's the unpredictability and I'll be happy to provide this information to the Commission. We've done an analysis based upon the future years' defense plan for the last several years of the Navy's shipbuilding plans, and the out years always look wonderful, they're very robust, very healthy.

But when those years start to become closer and closer, the number of ships they plan for go in half if not to one-third, and it's very difficult, not just for the shipyards but for the companies that manufacture all the systems and components to be able to plan accordingly, and of course, the number of ships, the fewer there are, the more the price is going to increase for the various components and systems.

Commissioner BECKER. I have one last question that I would like to submit to you in writing and you can take it with you.

Cochair WESSEL. We may have time at the end for another round. Commissioner Mulloy.

Commissioner MULLOY. Thank you. Dr. Howard, thank you for spending some time yesterday, and I'm not going to quiz you today because I want to go ask Mr. Lewis a question.

Mr. Lewis, in response to a question from Commissioner Reinsch about visas, you indicated that it's helpful because the foreign governments are, in effect, subsidizing some of our R&D. But then you added that the students staying in this country are in decline. Are Chinese students staying in this country in decline as well?

Dr. LEWIS. Yes.

Commissioner MULLOY. From the PRC?

Dr. LEWIS. That's correct.

Commissioner MULLOY. Part of the process then is you're moving your own industrial base to the people who are making the goods, and we should be happy that we're getting subsidies with all these cheap goods.

Of course, we won't have any capacity or good jobs for our own people after awhile. I think it's the same thing in this visa area. I think there's a problem here. When we take all these foreign students and the National Science Foundation gives them grants and then they go home and we don't have our seed corn and our own kids able to make this stuff, I think that's a problem.

Secondly, Tom Friedman in his book The World Is Flat, I believe on page 235, refers to the fact that American students sometimes go into a class taught by these foreign instructors and can't understand the class and maybe get discouraged from staying in those studies.

So I think this issue is more complicated than the discussion that you originally had with Commissioner Reinsch. But that isn't the key point I want to talk about here. You say in your prepared testimony that our market oriented approach emphasizes private investment and decisionmaking appears to be more effective than say Japan or Europe, but then you say confidence in this laissez-faire approach can be difficult to maintain in the face of the rapid growth of China's tech industries, and then you describe the fact that China had a national strategy to build a high-tech economy

called the 863 Program, and that this program was designed to move China up to a high-tech economy.

Of course, you want to be high tech because that's where the higher value added income, jobs, industrial strength, national strength come from.

CSIS has done an enormous amount of good work and Kurt Campbell was an early participant in this Commission's hearings and we thank you and them for all they've done. Has CSIS done any thought of not industrial policy because that's out of favor, but a national competitiveness strategy? Are we thinking what is happening to us and what we ought to be doing about it?

Dr. LEWIS. We have done a little work on that, Commissioner, and I'd say as in some of the earlier remarks that we've heard from both the Commission and from some of the panelists, the U.S. remains innately superior. We retain strong competitive advantages. These advantages face new pressures. We're in a much more competitive environment.

We see the risk of some erosion, and there are things the U.S. could do. You had the earlier discussion of industrial planning—it's not industrial planning, but there are areas where we could strengthen or accelerate our ability to be economically competitive, and we have done a little work on that. I'll be happy to send it to you and the Commission.

Commissioner MULLOY. Is CSIS doing work in that area of national strategy of competitiveness or how to compete in a global economy?

Dr. LEWIS. We are doing a little work in that area. To date it's focused on two elements. The first element would be the question of how do you build trust in a global supply chain? The second would focus more on strengthening innovation, strengthening basic research. As Dr. Howard noted, basic research investment has fallen in the U.S. in the number of years. This Administration has done a good job in increasing the level of R&D, but it has not increased it in some key areas, and if I were going to summarize this for you, I would say that the country with the most physicists wins. All right.

And currently that's us, but if trends continue, that will not be the case in five or ten years.

Commissioner MULLOY. Thank you very much.

Cochair WESSEL. Commissioner Dreyer.

Commissioner TEUFEL DREYER. My question is for Ms. Praeger, who mentioned that for the first time in anybody's memory, there is no new submarine design on the books. The last one, as you know better than I, is the Seawolf, which was extremely controversial, with some people arguing that we should build it at all because it's so expensive.

What would you reply to people who say, "given the fact that no country that is liable to be the enemy of the United States is anywhere near the United States in its ability to deploy sophisticated nuclear submarine technology, why are we spending the money on this?" I guess the only argument that comes to mind, and it's not a bad argument, but it may be the only argument, is that otherwise the U.S. will lose the capacity to produce advanced submarines.

I have a second part to this question. Is there any hope of getting around the anti-diesel electric submarine lobby in the Navy so America can start building diesel electrics again? This actually might make more sense in terms of certain battles the United States is liable to have to fight.

Ms. PRAEGER. To respond to the first part of your question, in terms of their not being an enemy that's deploying submarines, China is investing heavily in its submarine capacity. They started by buying submarines from Russia.

Commissioner TEUFEL DREYER. Yes, kilos.

Ms. PRAEGER. Yes. And now they're working on building their own from scratch designs, and their goal has been submarines because they understand how essential they are to a blue water Navy and that's stealth. You can see what's on the horizon when a fleet comes in, but you don't know necessarily unless you have incredible sonar capabilities what's underneath.

They know that while their technologies may not be as advanced as ours, submarines are the answer in terms of being a threat to the United States fleet. I put in my written testimony how they're focusing all of their efforts on submarine technologies right now, and will most likely if they stay on their present course surpass our submarine fleet in size by 20 percent.

Commissioner TEUFEL DREYER. I read that, yes.

Ms. PRAEGER. I guess to talk about the second part of your question, the shipbuilding industry responds to whatever its customer, the United States Navy, wants. It really is the focus and while nuclear is much more expensive, we will respond to whatever our customer wants.

I know the Navy has been investigating alternative sources, alternative designs, and that's something that is ongoing and it just depends on what their response is from a national security standpoint that in due course the industry will satisfy.

But it's essential to keep the skill base and you mentioned the Seawolf program. We'd like to bring up the industrial base of that. That program was terminated after three submarines and it nearly destroyed the U.S. submarine-building industry because companies overnight found themselves with components that suddenly were not going to be purchased or produced.

Commissioner TEUFEL DREYER. Okay. If I could just follow up on that one. What do you say to people—what I'm doing is asking you to help me out; I'm on your side on this one, but help me out—to people who say, "Look, the last DoD report on the military capabilities of the People's Republic of China said it will be 20 years before they catch up with us in technology." What do you say to that?

Ms. PRAEGER. In all fairness, I'd like to allude to what was raised briefly with the other panel: that the intelligence networks are now admitting they don't know what China has. And you need to be better than your enemy, to, in other words, be prepared for your enemy, and we had the opportunity to review a report that was done by Congressional Research Service where defense intelligence analysts had admitted that when they were reviewing satellite technology, they noticed a submarine under construction in China—under construction—that the United States believed was ten years away from even being developed.

We have got to begin focusing on the threat. They know what we have. We don't know what they have, and that's that danger that we have to be prepared for.

Commissioner TEUFEL DREYER. Thank you. This has been a big help to me.

Cochair WESSEL. Commissioner Donnelly.

Commissioner DONNELLY. Thank you, Mr. Chairman. I would like to ask a series of rather brief questions to everyone beginning with Ms. Praeger. Is it fair to say that there's a fundamental mismatch between what the Navy is willing to support budgetarily and the current size of the shipbuilding industry? That there's a mismatch between shipbuilding budgets of something in the nine to $11 billion range in a program that would cost something like 13 to $15 billion per year?

Would you accept that estimate of the differential?

Ms. PRAEGER. That would be correct, sir.

Commissioner DONNELLY. In that case, isn't there an argument to be made that there's an excess of shipbuilding capacity not only in terms of the number of yards, but also in terms of the utilization rates of the yards that currently exist?

Ms. PRAEGER. Our yards have the capability to produce much more than they presently are producing. With understanding the changing dynamics of the world and after the Cold War, the largest naval threat to us was diminishing in size, and so, of course, just with every aspect of the defense of this country had to scale to match the new global threat.

China is investing so heavily in building a Navy that is designed specifically to take on the premier naval power of this world, which that is the United States. They are understanding that sheer numbers matter in a battle and not only in a battle but protecting sea-lanes of commerce. They are building a naval fleet that cannot only be a defensive threat but to be offensive and serve as protecting its commercial interests abroad and its commercial sea-lanes.

So from the industry standpoint, we feel that the United States does need more ships, but you always need to make sure you maintain that industrial capability, that skill set, that knowledge, those components, because we are seeing China building to such an extent that they are going to pose a threat; if not a direct threat, it's going to be a force that is going to be out there, and we feel that you need to make sure the United States maintains the capability to be able to respond to any threat that may come.

Commissioner DONNELLY. I would certainly agree with all that. But just as a matter of American defense industrial policy, aren't we at the point where we either have to, particularly when we're coming down as you suggested in your testimony, to questions about whether we go to sole source yards for particular classes of ships, that we have to make a choice either to significantly increase the shipbuilding budget or to reduce our capacity and there is really no other way to slice that any further?

Ms. PRAEGER. Well, the danger with going to the sole source is reducing competition. Right now, as I mentioned, with the exception of the aircraft carrier, there are two builders of submarines, two builders of surface combatants, two amphibious, two auxiliary builders.

If any one of those goes away, you're going to be placed in a situation of sole source, which, of course, prices are then going to rise even higher than they are now, which then the threat becomes Department of Defense saying let's go foreign for everything.

Commissioner DONNELLY. Well, considering we're paying a premium for under-utilization of the yards that we have now—in other words, we only build one submarine per year, so we're paying the overhead on maintaining two yards' worth of capacity but only using it, and given again the under-utilization of the yards we have, we're paying a heck of a lot of overhead for the number of submarines that come out every year.

Again, I believe the solution ought to be to build more submarines, but we're caught on the horns of a particularly difficult dilemma where we have, again, an industrial base that was structured and then ordered to maintain a far larger fleet than we currently have. What's really skewering the Navy is the disconnect between the industrial base and its actual budgetary levels. Is that fair to say?

Ms. PRAEGER. That's an assessment, but then the argument that we like to pose is that if you increase production, increase your production throughput, your prices are going to fall, and then it makes the ships more affordable for the Navy.

Commissioner DONNELLY. Sure. The unit cost will go down, but the overall number, again, has to go up by four or $5 billion a year in order to maintain the fleet size that would maximize efficiency.

Ms. PRAEGER. We're overcoming years of under-investment to get where we need to be.

Commissioner DONNELLY. I would agree. Similar questions for the other two panelists in this regard: Isn't the fundamental problem whether it's 6.1 and early levels of S&T investment by the Department or the particular problems of unique chip manufacturer, that troubles of the industry and the dilemmas that they find themselves in are mostly a reflection of declining DoD top line over the past ten or 15 years?

In other words, everybody's pie has shrunk and, consequently, research and other engineering capacities that again reflected Cold War levels of spending are simply in excess of what current procurement and research budgets can support?

Dr. HOWARD. Why don't you go ahead and I'll follow after.

Dr. LEWIS. Let me talk briefly about the research budget issue, which is that funding for research has gone up. What it has done is it hasn't gone up necessarily in the areas that are of greater utility to the military. The bulk of our research funding now goes to the life sciences. It goes to medicine.

There's a number of reasons for that, but the result, and of course it's very valuable to have them go there, but the result is we're underfunding things like physics, computing, engineering, material sciences. In large part, that is, in part, that is a reaction to the end of the Cold War. We might have been a bit too quick to cash in the peace dividend. But it's also this investment priorities or what I would call misallocation of investment priorities.

We spend more than any other country in the world on R&D. R&D has gone up. What we need to do is think about if we want to shift where we spend that money.

Dr. HOWARD. The decline in research and development, the research side of, university side of the research issues really started about 1970, well before the Cold War ended, and was a reflection of the focus on nearer term issues within the Department of Defense and, in fact, an industry.

Universities historically have been the place where a single faculty member with a group of graduate students can pursue an idea regardless of how countercultural it may be within the field, to the point of determining of whether it works or doesn't work and whether it has utility or not.

That part of it has, if you look at the total national investment in basic research, more and more of this has shifted to use-focused——

Commissioner DONNELLY. Engineering development things.

Dr. HOWARD. Yes, relatively short-term engineering development and less on the more exploratory part and that's where we're beginning to—we've been drawing water out of the research results well for a long time, and we haven't been putting much back in it. And the cistern is getting a little low.

Commissioner DONNELLY. I see my time is up.

Cochair WESSEL. Thank you. Commissioner Bartholomew.

Commissioner BARTHOLOMEW. Thank you very much, Mr. Chairman, and thank you to our witnesses. This has been a very interesting panel. Dr. Howard, what are the implications for the United States, for us, if the Chinese take over Taiwan given the foundries that are in Taiwan and the chip manufacturing capacity there?

Dr. HOWARD. Well, what it means is that there potentially could be a different set of access rules applied to those foundries than we have had in the past. One can't say for sure because China has adopted in the case of Hong Kong the one-country-two-systems philosophy in an attempt to maintain Hong Kong as a model for commercial development or for business development, so one can't speculate in the case of Taiwan exactly how they will apply their controls and their concerns about government to that.

But certainly it's reasonable to expect that we will be concerned about it and we will do a number of things on our side to try to pull in things that we view of being of importance.

On the other hand, we have already—the commercial side has already built a lot of semiconductor capacity in China, Nanjing and a number of other places, Shanghai. And China has been a large market, a large commercial opportunity that the industry has gone after.

The issue that we're concerned about in the high performance micro electronics study is that the national interests of the United States diverges from the commercial interests of the industry, and since the U.S. represents such a small fraction of the total semiconductor business, the government has a problem in which industry does not share.

And it's a search for a solution to that problem that I think the Defense Department and the other agencies which are critically dependent on some of this technology are already concerned, whether or not the circuits are built in mainland China or in Taiwan.

Commissioner BARTHOLOMEW. You specifically mention concern about the possibility that Trojan horses and other unauthorized design inclusions may appear?

Dr. HOWARD. Right.

Commissioner BARTHOLOMEW. Do you think that that concern would increase?

Dr. HOWARD. It would certainly make things simpler for somebody who wanted, for the Chinese to be able to do that kind of thing should they desire to do it, yes.

Commissioner BARTHOLOMEW. Both Dr. Howard and Dr. Lewis, I have a tendency to go a little bit outside the topic at hand, but there is some connection, and that is with the development of IPv6, my understanding is that the Chinese are very actively engaged and in the forefront on IPv6, and we had a hearing a couple months ago about Chinese control of the Internet.

I wonder if the development of IPv6 under this kind of situation raises any concerns for you?

Dr. HOWARD. Since I'm speaking basically on the basis of a Defense Science Board study on hardware technology, I'm out of my area to comment specifically on that. I would be happy to talk to you informally later.

Commissioner BARTHOLOMEW. Okay. Great. Dr. Lewis, any thoughts?

Dr. LEWIS. I don't think that the IPv6 in and of itself should be of concern. What we might want to pay more attention to, if only for competitive reasons, is China's efforts to move into the international standards arena and to help set or shape standards for information technologies like IPv6. This is an area where at least on economic grounds, there is ground for concern.

Commissioner BARTHOLOMEW. Thank you.

Dr. HOWARD. Incidentally, I would add that the Defense Science Board does have a study, a parallel study to this, relating to communications and software.

Commissioner BARTHOLOMEW. Great. Okay.

Dr. HOWARD. Which you'll see in about six months.

Commissioner BARTHOLOMEW. Wonderful. Thank you very much.

Cochair WESSEL. We're one of those unique Commissions, I think, where we actually listen to one another, and Mr. Donnelly, Commissioner Donnelly, I heard your admonition this morning that we connect the defense industrial base and China, and I'm going to try to connect the two as it relates to shipbuilding and understand it and recognizing that I am a strong supporter of a large and robust Navy.

Ms. PRAEGER. And we thank you for that.

Cochair WESSEL. I don't vote in Congress so it doesn't get you a lot. It seems, and the question of BRAC came up, the question of our own defense budget and the inability for the industry to do forward planning, all the various other things, cost structure, are key issues, and they are the ones that we are causing on our own.

What is China's impact on our own shipbuilding industry? What negative repercussions on our defense industrial base are they having or are the problems we're facing basically all of our own making?

Ms. PRAEGER. Well, China definitely has its own designs in terms of it understands how imperative shipbuilding is not only for the economic strength of the country, but how strong, how important it is for its own defense. To touch on the component manufacturing side, because that's where we have seen the most decline in terms of companies that were prominent companies that were in business ten years ago that are no longer in business today—because of low production rates, they've been forced out or they've been bought by a foreign competitor and moved overseas—China knows, as I know this Commission has investigated with its other hearings, the low cost of production and companies going to China to produce systems and components. China has made it known that on the naval side or the marine side as a whole that while it presently occupies 40 percent of the ability to manufacture systems and components domestically, it wants 100 percent.

It knows the value of being reliant upon no foreign source for critical systems and components, and through developing its own systems or buying companies or encouraging other companies to come over there so that they can learn how to design certain aspects, they know that if they become completely self-sufficient that they, for lack of a better word, can call the shots and can make everyone else reliant upon them.

That's very dangerous for this country and while the nuclear side is a little bit different story because of the technologies involved, it is very much a concern that any component that's critical to any class of naval ship, we could find ourselves in the position of always having to go to a foreign source, namely China, to get that component in our system.

It's the lack of protections, and additionally, as I mentioned with the shock testing, when it's built to U.S. specifications, we know that that component or system can take a hit from enemy fire and probably survive. Otherwise, it would not be on the naval ship. You have no such assurances if that's made in a foreign country.

Cochair WESSEL. At our own shipyards, I assume that there is commercial to the extent we're still producing commercial ships, it's built in those yards. The subsidies that China, the Koreans and others are providing to their commercial shipbuilding, I assume that's had a big impact on our shipbuilding industry in terms of pulling demand away and that has an impact on the cost structure?

Ms. PRAEGER. Absolutely, sir. That's back in the 1980s when the United States did away with its commercial shipbuilding subsidy, the commercial shipbuilding industry almost disappeared overnight. Everything went briefly to Europe and then to Japan, which had made it a point that they wanted to become the world's largest shipbuilder. In the 1970s, they occupied, they were growing a market share. South Korea looked at that plan in the 1990s, employed the same technique, and right now is the world's largest shipbuilder with about 30—commercial shipbuilder—with about 32 percent of the world's market share.

China, looking upon the models of what Japan and South Korea have done, is thinking this will be great. We can do this as well and they have. And when you consider the time span of which they've done that, that they presently occupy around 14 percent of

the commercial shipbuilding market share, and it's anticipated that they'll have 25 percent within five years. It's that build-up, it's that goal that has pushed the market to the—it's with the subsidies and when you have the subsidies you can get your prices down, your orders up.

The United States simply cannot compete commercially. We right now occupy less than one percent of the commercial shipbuilding market and that is only for our domestic Jones Act trade which by law requires the ships to be made here.

Cochair WESSEL. Have we done anything about these subsidies at the WTO or elsewhere?

Ms. PRAEGER. The European Union has taken on that issue and they have not really been effective because the European Union subsidizes as well. But to be perfectly honest and fair, when it comes to commercial, the United States, we cannot compete because it's not a level playing field.

Cochair WESSEL. But if we were able to get more commercial shipbuilding back, we'd be able to address some of the cost structures of the yards and deal with, in terms of keeping the workers on, in terms of getting product through, you'd be able to sustain a larger base rather than worrying, as Commissioner Becker talked about—a ship goes off-line, you lose these employees and you've lost the capacity to produce. Is that right?

Ms. PRAEGER. That's absolutely right, sir. The industry has always depended upon commercial and naval in conjunction. If you have a low build period in one, you anticipate that the other will pick up the slack. With no commercial to fall back on, you become completely dependent upon naval. If you were to increase commercial shipbuilding in this country, because a lot of components are a crossover for naval and commercial ships, you would see a decrease in the price of naval ships as well.

Cochair WESSEL. I don't know if there were any initial questions. We had two followup questions——

Cochair WORTZEL. I have some shipbuilding questions. You're the first shipbuilder I've ever had contact with so I'm glad to ask a couple. Actually I've asked them a lot and I've never had them answered.

Chairman D'AMATO. You were in the Army, weren't you?

Cochair WORTZEL. I was, but I was a Marine. You deal with deadweight tonnage capacity in China and the shipyards. But you never give us deadweight tonnage capacity of American shipyards. Even if they're idle, if all the workers have gone home and are on unemployment, what's the capacity if we had to surge and build? So that would be one.

I'm going to pile on to you. You can answer what you know and ignore what you don't know. But I've got a series of them.

Ms. PRAEGER. Okay.

Cochair WORTZEL. This is like ten years' worth of Navy questions. You spend a lot of time concentrating on the fact that Chinese or American ship components are shock tested. We know if somebody dumps a five-inch shell or a torpedo into an American ship. All the components are shock tested. That means they're going to survive at sea. Crews are going to survive. You can go to war in them.

Are Chinese ships shock tested to withstand enemy fire? And if not, do we need as many ships to blow up the Chinese? I'm interested in cruise time. If you're going to have a power projection Navy that can go anywhere in the world and fight anywhere in any sea lines of communication, can Chinese submarines remain submerged for months and months?

And then I'm interested in the relationship between sub-systems on a ship, and this is one I have never had answered, American ships, as I understand them, American Navy ships can make fresh water whether it's submarines or surface ships, you make water. You can drink it when you go or you can underway replenish.

But when you're on Chinese ship, and you leave port, a military ship, you offload ammunition to on-load bottled water. No Chinese ships make water. Do Russian ships make water? You know, they had a power projection navy.

Is there a relationship between the number of ships the Chinese have that are supposed to be combat ships and their power projection capability, and is that affected by the number of water bottles they carry versus the number of five inch shells? Because I think it's an important question.

And then can the Chinese still at this point make or can they make naval turbine engines and propulsion systems or are they dependent on foreign suppliers for that part of the Navy ship, whereas they can manufacture a hull or a shell? So that's a whole series of them.

Now, I do want to take issue with a couple of your statements you have in there, and I think you would support your own argument better if you took a look at Chinese naval construction between 19—roughly—77 and 1988, and not only naval but commercial ship construction. The Chinese in that period had a huge surge in amphibious ships, LPHs, not LPHs, but in LSMs particularly, but LSMs were a big push for them.

So they were able to do that. They also had a huge surge in roll in/roll off construction. They were about the only guys in the world building roll on/roll offs. Then they dropped off; you're right. From '89 to somewhere when the Defense Intelligence Agency lost sight of the fact that the Chinese were building ships, they did drop off in about '89 and concentrated on other things.

But when I was looking at the Chinese Navy, they had begun to construct at sea oilers. They had begun to construct underwater replenishment ships. They had the largest roll on/roll off construction capacity and production rate in the world at that time. So they did construct, have navy shipyards before 1989, and I think you would reinforce your case if you moved back a little earlier.

They didn't do anything in the Cultural Revolution from 1965 to about 1985 or so, or 1975 and 1978, but then they got real big into it. So what you can answer will be great. But I've been really interested in the relationship between the ability to produce water on a ship and what that means for power projection capacity.

Commissioner BARTHOLOMEW. Mr. Chairman, before our witness tries to answer those questions.

Cochair WESSEL. His time has expired, so please.

Commissioner BARTHOLOMEW. When we were out in Seattle we had someone from the spearmint oil producers and some of us

hadn't even ever thought of spearmint oil before. There are many questions that come up, so no one should feel particularly targeted with some of these questions.

I would note, Commissioner Wortzel, that you were asking extremely technical questions about Chinese ships, of somebody who works for American shipbuilders.

Cochair WORTZEL. Oh.

Commissioner BARTHOLOMEW. So perhaps if she can't, I'm presuming——

Cochair WORTZEL. But Chinese ships are the threat.

Commissioner BARTHOLOMEW. Perhaps if she can't answer the question, she could help us identify someone who could. But that said.

Ms. PRAEGER. Well, I appreciate that caveat. To touch on that, it is difficult to know the technologies that are on board, and I think that goes to even the larger Navy as a whole.

It's difficult. That's something where speaking from an industry perspective is difficult to know, because not a great deal of intelligence has been devoted to examining what they have or do not have and what the intricate capabilities are.

So to answer the water question, I do not have the answer to that. In terms of some of their technologies, you mentioned engines. They have been relying on some of those components from Europe, and because of diesel engines, for example, are considered dual-use and because the Chinese government does not distinguish—with the government owning everything commercial and military does not distinguish, so buying an engine from Germany and then installing it into a military vessel.

But they are relying on Europe for a great deal of their dual-use technologies with the idea of beginning to develop that domestically as I mentioned with the 40 percent.

Cochair WORTZEL. But if you went to war with them today and your European allies stopped selling turbines, they couldn't reconstitute?

Ms. PRAEGER. Today that's probably a fair assessment, sir. You also mentioned in terms of shock testing that also goes to the technological capability. We really just do not know the nuts and bolts of what they do have and do not have at this time.

To refer back to your capacity question, you're right. The United States, we do not rely solely on deadweight tonnage for measurement. That's an overgeneralization, but that's a commercial shipbuilding measurement because it's a large vessel.

Since we predominantly construct naval, we measure it in terms of displacements tonnage, and that's, as my shipyards have explained to me time and time again, it's an apples/oranges comparison because you're dealing with something small, fast, swift and full of weapons versus something that can carry a large deal of cargo.

We think in terms of volume, in terms of capacity, and right now to give you a comparison as to where we are in the rest of the world and will our shipyards have the capability to produce much more than they're presently producing, Hyundai Heavy Industries in South Korea, which is right now the world's largest shipyard,

produced 60 ships last year, and the United States shipyards were about two ships on average per shipyard.

So that shows you when you have the volume, when you're producing quite a bit, and it goes to why the South Koreans are also able to produce the lowest ships right now in terms of cost, is because they have that volume throughput. But I hope that answers your capacity question to an extent.

The larger your facility, obviously the more you can produce, and they right now have the largest, and China is building or has invested and has started to build the largest shipyard in the world south of Shanghai.

Cochair WORTZEL. Thank you.

Cochair WESSEL. For a final, very quick question, Commissioner Mulloy.

Commissioner MULLOY. Dr. Howard, you taught at Berkeley at one point?

Dr. HOWARD. I infected the minds of students at Berkeley, yes.

Commissioner MULLOY. Dr. Lewis tells us that the percentage of Chinese students who are staying in the United States is in decline. Is that your understanding based on your contacts in the academic community as well?

Dr. HOWARD. My information is only anecdotal. I have not tried to gather a validated database on it. Anecdotally, I would say that there are. I know of Chinese who have returned to their families in their family's homes in China. I also know of a whole number of them that have come here and stayed.

Commissioner MULLOY. Right.

Dr. HOWARD. And I have no idea what the balance is and how it's changed.

Commissioner MULLOY. My understanding is that the Chinese government is now offering incentive programs to bring those students home.

Dr. HOWARD. I'm aware of that.

Commissioner MULLOY. Is that your understanding?

Dr. HOWARD. Yes.

Commissioner MULLOY. Dr. Lewis, what was your database for making the statement you made that the number of Chinese students or percentage is in decline based on what it was, say, five years ago?

Dr. LEWIS. If I remember correctly, the National Science Foundation puts out annual figures on this, and so that would probably be the source. I can't remember if the last figures were 2003 or 2004.

Commissioner MULLOY. Could you provide that to the Commission?

Dr. LEWIS. Sure, yes.

Commissioner MULLOY. That would be very helpful for us to know because I think that's an important policy issue as you're looking at this whole visa and R&D and student training and National Science Foundation. So thank you very much for that help.

Cochair WESSEL. Thank you, and that concludes today's hearing. Did you have another question, Mr. Donnelly?

Commissioner DONNELLY. May I?

Cochair WESSEL. Please. I did not get a signal.

Commissioner DONNELLY. I will be really brief. I have two questions that could be answered for the record. I'd like to know the witnesses' views on whether DoD inventory policies have exacerbated industry trends wherein we have simply fewer parts on the shelves, so given questionable supply chains because of changes in commercial practices, whether we're exacerbating that by reducing our military inventories?

Secondly, a question about software. It's my understanding that as weapons become more sophisticated, in the F22, for example, more than 50 percent of the cost is actually software costs, and whether there is a similar set of risks that we are running that's analogous to the changes that happened in the IT sector and the chip sector, for example, that would be reflected in future risks in regard to software for weapons programs.

So no point in going into them now unless you got a quick answer.

Dr. HOWARD. Well, very quickly, the Defense Department has always maintained inventories related to what it foresees the life time, not the life time, the immediate use of need for spares and for current production.

I know back as far as 1978 that in certain components that my company was building, we tried to get them to do lifetime buys and they just refused to do it. And we stopped making the component and then all hell broke lose when——

Commissioner DONNELLY. When the use rates don't follow the anticipated path.

Dr. HOWARD. Yes, that's right.

Commissioner DONNELLY. Yes.

Dr. HOWARD. The question about software, the answer is absolutely yes. Software has very similar risks involved. In fact, the design of a complex integrated circuit chip, leading edge circuit chip, is quite analogous to a complex software-writing program. They're really very much the same viewed in the large. And very much the same opportunities for mischief apply in that case as apply in the case of hardware. And when you put the two of them together, you compound the opportunities.

Dr. LEWIS. Where we are now in software is that the capabilities still reside in the U.S. It's the low end that has been outsourced. The two issues we'd want to watch for are as the number of graduates in IT decline in the U.S., we may not have the capability to write the software we need or we may not have American citizens capable of writing it.

The second thing we need to watch is there's always the temptation to outsource some of the code somewhere. We don't have a good system for monitoring that. We don't have transparency into who the suppliers are.

So currently I don't think this is a major problem for most military software, but it's something that would need to be carefully watched over the next decade.

Dr. HOWARD. One addition to that. In addition to the special purpose military software, the Department uses a fair amount of standard software packages, which it buys off the shelf or in the practice of business, and many of those are not generated in the U.S. In the business world, a particularly well-used program is

called SAP, which is used to manage a business and inventories and orders and all that, which my German friends call "software as Pakistan."

So you can't tell where these things are written and a good example of a non-threatening example of some of the problems in software are go on to the Net and Google the words "Easter eggs," and you will discover a whole listing of products, standard software products that have a few extra items in them.

Some years ago, Excel had a flight simulator built into it to entertain the programmers when they weren't——

Commissioner DONNELLY. Just sitting there working.

Dr. HOWARD. Yes. So there are things like this that have gone on for a long time that are non-threatening. But the fact that you as a user don't know that those exist, and furthermore no reasonable amount of testing would turn these things up. You can't put trust into a product after it's made. You've got to be sure that it's made in a trustworthy fashion. It means that you have to be very careful about these things.

Dr. LEWIS. Let me just put one more note in here which is there is an NSA–DoD study that you might want to try and get a hold of that looks at how you build trustworthy systems out of untrustworthy components, and if you can't find the—because that's the world you're going to live in whether you like it or not—and if you can't find this site, I'll provide it to you. I think there is an unclassified version.

Commissioner DONNELLY. Thank you. I appreciate both the panel's indulgence and the Chairman's indulgence.

Cochair WESSEL. Thank you and with that we will adjourn for the day. Thank you.

[Whereupon, at 4:45 p.m., the hearing was adjourned.]

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BOEING'S DIFFUSION OF COMMERCIAL AIRCRAFT DESIGN AND MANUFACTURING TECHNOLOGY TO JAPAN: SURRENDERING THE U.S. AIRCRAFT INDUSTRY FOR FOREIGN FINANCIAL SUPPORT

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Abstract

This paper offers a critical commentary on the technology transfer through commercial aircraft outsourcing that has had a major impact on developing the build and design capabilities of the Japanese aerospace industry. This has evolved from a simple "build to print" subcontractor relationship to a turnkey "design and build" risk-sharing partnership. Using the Boeing 767, 777 and 787 as examples, we argue that the motives for Boeing's commercial outsourcing to Japan are to access the market, spread risk, gain access to capital, and lower U.S. spending on research and development. This has clear implications for U.S. trade and employment, in that Japanese subcontracting boosts foreign imports and reduces the need for domestic production workers and U.S. suppliers. From a trade perspective, however, a potentially troubling feature of allowing the Japanese to produce large commercial aircraft subassemblies is that major Japanese public financial supports are involved which contravene existing international agreements on production subsidies. This paper reviews the types of production contracts that Japanese companies have sought on the Boeing 767, 777 and 787 programs. These contracts have allowed the Japanese to develop new capabilities in terms of production capacity, tooling, design and final assembly. Ultimately, these capabilities imply that Japan will eventually enter the market as a fully-fledged producer of commercial aircraft. This does not bode well for the western aerospace sector, since the Japanese government has recently funded a research program to produce a regional jet aircraft.

1. Introduction

The commercial aircraft industry has long served as a symbol of U.S. export leadership in product-markets that require high levels of design and engineering innovation. This industry has been the top U.S. export sector for more than 50 years (United States Department of Commerce, 2004), and many of the advanced production and engineering procedures developed by this sector have been successfully transferred to other U.S. industries (e.g., automotive, electronics, metal fabricating). In recent years, however, the U.S. commercial aircraft industry (NAICS 336400) has experienced substantial employment decay, reduced exports, and rising foreign competition. On the employment front, for example, the industry moved from 552 thousand jobs in 1994 to an estimated 432 thousand jobs in 2004 (a loss of 120 thousand positions). Contrast this with 1990, when the industry accounted for over 840 thousand jobs. In the space of only 15 years, this sector's employment base has been cut in half. Significantly, the U.S. Bureau of Labor Statistics (2004) forecasts a further 17 percent employment decline by 2012.

The export picture is equally disturbing, in that overall trends for SITC 792 (aircraft and associated equipment) have been downward since 1998. For example, total exports in 2002 were approximately $44 billion, compared to $52 billion in 1998 (a drop of 15 percent, or $8 billion). While part of this can be blamed on shrinking commercial aircraft orders in the post-9/11 environment (as well as increased competition from Airbus), the trend toward global outsourcing for components and assemblies is also part of the story. In recent years, for example, the sole remaining U.S. manufacturer of large passenger jets (Boeing) has opted for a systems integration mode of production. Under this system, key components and sub-assemblies are designed and manufactured by external suppliers. Boeing has especially favored Japanese companies for major subcontracts (see Pritchard and MacPherson, 2004A). While this represents a logical strategy from a financial standpoint, a potential downside is that the Japanese subcontractors and/or risk-sharing partners must re-

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ceive infusions of tacit scientific and technical knowledge from Boeing (otherwise the strategy would not be effective). This raises an important question that ought to be of interest to trade policy analysts that are concerned with national industrial competitiveness. Specifically, to what extent does technology transfer to Japanese companies represent a good idea in terms of long-run economic or industrial effects for the U.S. aerospace industry?

Set against this backdrop, our paper is organized as follows. Section 2 provides a research context for the discussion. This section reviews the evolution and development of industrial offset agreements and other types of production sharing arrangements with the Japanese aerospace industry. Next, Section 3 reviews the Japanese aircraft industry as a 'National Project' that has developed under Boeing's industrial offset programs. Section 4 discusses Boeing's growing dependence upon Japan's composite technology due to a lack of U.S. investment in materials-based research and development (R&D). Section 5 introduces a number of new strategic issues with regard to Boeing's 787 aircraft launch. Japanese companies for the first time will be selecting second and third tier suppliers. Section 6 reviews the Japanese funding on the Boeing 787 and World Trade Organization (WTO) issues which could delay the first delivery of the 787 in 2008. The paper concludes with a brief discussion of the strategic issues that arise from these developments. We believe that the Japanese commercial aircraft industry will soon create its own stand-alone aircraft program while simultaneously developing a low-cost Asian supplier network.

2. Research Context

The term 'industrial offset' refers to a compensatory trade arrangement where the exporter grants concessions to the importer. In the commercial aircraft industry, these concessions typically take the form of production-sharing agreements.[1] One of Boeing's early offsets was with Japan in 1974, when Mitsubishi was given contracts to produce inboard flaps for the Boeing 747. Major sales of 747s to Japan followed. In most of these cases, the goal has been to secure a sale that would not have taken place in the absence of compensatory provisions. Boeing has become the nation's largest corporation in terms of offset-related commitments (Pritchard, 2001). In 1960, imports of aircraft and parts amounted to only 5 percent of aircraft exports by value. Today, that figure is 45 percent. Foreign content for the 787 might run as high as 70 percent. The foreign content of a Boeing 727 in the 1960s was only 2 percent. For the 777 in the 1990s, foreign content was nearly 30 percent.

As part of the launch process for the 787, three Japanese companies are expected to create the manufacturing processes for final assembly of the wing. Boeing has never considered subcontracting wing production to external suppliers before. Given that Japan has incrementally acquired production competence for a wide range of airframe components via years of industrial offsets from Boeing (see Pritchard, 2002), the transfer of wing manufacturing and assembly expertise to Japanese companies effectively gives Japan 'total production competence' with regard to commercial airframes. Japan has already announced that it wants to produce commercial aircraft (Pritchard and MacPherson, 2004B). In fact, Mitsubishi announced in 2002 that it was conducting a joint feasibility study with Boeing for a 30 seat regional jet, which would receive $206 million of financial support from the Japanese government (Seattle Post-Intelligencer, 2002). In this regard, it is likely that Japan's first airliner will be an all-composite regional jet—a competitor to Canada's Bombardier and Brazil's Embraer. Some experts believe that the next generation of Boeing's 737 will be an all-composite airframe produced totally in Japan.

3. Japan's Commercial Aircraft Industry-National Project

The Japanese Aircraft Development Corporation (JADC) is a consortium of Japanese aerospace companies that seeks to introduce advanced commercial aircraft programs. The main partners are MHI (40%), KHI (30%), FHI (20%), Nippi (5%), and SMI (5%). JADC is responsible for coordination of participation of Japanese Aerospace Industry companies in international projects promoted by the Ministry of Economy, Trade and Industry (METI).

The national goal for METI and the industrial sector has been to revitalize Japan's aeronautics industry. The industry is now being aided by a METI-financed foundation, the International Aircraft Development Fund (IADF). This new foundation has offered the 3-company consortium (Japan's aircraft manufacturers) a $3 bil-

[1] While Airbus also operates with industrial offset agreements, these agreements are typically for older Airbus products. Newer models are more often sold with indirect offsets (e.g. the provision of landing rights to major EU airports such as Heathrow and Gatwick).

lion low interest loan to ensure Japan's participation in the 787 program (Sakai, 2004).

The goals of JADC are to advance and further the development of civil aircraft through research and other appropriate means so that it may promote the improvement and development of the aircraft industry. The JADC is a non-profit foundation established for the enhancement of Japan's aircraft industry with the approval of the Japanese government, and is managed by the top executives of the following Japanese aircraft companies (FAC, 2004):

- Mitsubishi Heavy Industries, Ltd. (MHI)
- Fuji Heavy Industries Ltd. (FHI)
- ShinMaywa Industries Ltd.
- Japan Aircraft Manufacturing Co., Ltd. (JAMCO)
- Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI)
- Japan Airlines Co., Ltd.
- All Nippon Airways Co., Ltd.
- Japan Air System Co., Ltd.

The Boeing 767 was the first U.S. aircraft program that entailed substantial international cooperation in developing commercial transport since 1970. It can be inferred that there were four major reasons for cooperation between companies in Japan and the United States at this time, including risk-sharing, enhanced capabilities through cooperation, participation in development/market entry, and mutual profit-taking.

The next project was the international joint development of the Boeing 777, which started in 1991 and continues today. The structure of partnership in Japan is almost the same as that for the B767. For the B777's development, Boeing and Japan Aircraft Development Corporation (JADC) constitute the core promoting organizations. Mitsubishi Heavy Industries (MHI), Kawasaki Heavy Industries (KHI), and Fuji Heavy Industries (FHI) are taking part in airframe development and production, playing a key role as program partners. Besides airframe manufacturers, some 30 manufacturers also have been involved in Boeing's commercial transport programs as suppliers and/or subcontractors. In 2004, JADC and Boeing agreed to the joint development of the Boeing 787. The Japanese heavy firms Mitsubishi, Fuji and Kawasaki are slated to build 35 percent of the 787 aircraft structure, which will include the design and manufacturing specifications in comparison to a build-to-print relationship on previous Boeing programs. The JADC received budgets for pre-development activity that supported sending 140 Japanese engineers to Seattle before the program contract was finalized between Boeing and the Japanese companies.

Thomas Pickering, Boeing's senior vice president for international relations, recently stated that "Japan did less than 10 percent of the (Boeing) 767 and 20 percent of the 777" (Shimbun, 2004). From 1978 to 1983, the Japanese government covered about half of the costs of developing parts built by the Japanese companies for the Boeing 767 (Belson, 2004). In the 1990s, Japanese companies spent 104.5 billion yen ($942 million) to develop parts for the Boeing 777, aided by a 60 billion yen loan from the Japanese government (Belson, 2004). Today, these three Japanese firms will have full responsibility for tooling their factories for wing production. "This is the first time we have ever put the full wing . . . into the hands of a partner," said Thomas Pickering (Gibbs, 2004). He further stated, "We said (Boeing) let's spread the risk and spread the benefit . . . they get the advantages but they also carry the burden."

Boeing says it expects contracts with its tier-one suppliers to be finalized by the beginning of 2005 (Table 1). The first tier suppliers will select, contract and oversee the second and third tier suppliers in mid 2005. The 787 program will be the first time that a first-tier supplier will control the selection process of second and third-tier suppliers in a Boeing commercial aircraft program. This should cause alarm to the U.S. supplier base, since the government of Japan will be subsidizing the 787 program up to $3 billion (Pritchard and MacPherson, 2004A). It should be expected that the aerospace infrastructure of Japan would be developed with new national suppliers being chosen for receptivity for the government funding. In an interview with Bill Lewandowski, Vice President of the Supplier Council for the Aerospace Industries Association, two concerns were raised: "the first being that upper tier U.S. suppliers (sigma three group) would probably be only offered to quote against Japanese second and third tier suppliers, and, secondly this U.S. group would have difficulty communicating with the overseas first tier suppliers since they aren't export ordinate." (Lewandowski, 2004)

A snapshot of the evolution of Boeing's outsourcing strategy is shown in Table 1, which tracks the growth of international production sharing for key aircraft components across four airplane programs. There has never been any significant foreign

content for early models such as the 727. From the 767 onwards, however, foreign partners have clearly become increasingly important.

Table 1. Outsourcing Trends for Boeing Airframe

Airframe	727	767	777	787
Wing	US	US	US	Japan
Center Wing Box	US	Japan	Japan	Japan
Front Fuselage	US	Japan	Japan	Japan/US
Aft Fuselage	US	Japan	Japan	Italy
Empennage	US	US	Foreign	Italy/US
Nose	US	US	US	US

Equally important is the fact that Boeing's outsourcing arrangements over the past 30 years have expanded from simple structure parts on the 747 to complex center wing boxes for the 777 (Boeing, 2005). Below is a listing of major component subcontracts to Japan that covers Boeing commercial aircraft programs (717, 737, 747, 757, 767 and 777):

MHI (Mitsubishi)
- Inboard TE Flaps 747–400
- Inboard Flap 737–600/–700/–800/–900
- Passenger Entry Doors 777–200/–300
- Fuselage Section 46, 47, 48 777–200
- Bulk Cargo Door 777–200, 777–300
- Pressure Dome Bulkhead 777–200
- Entry Service Doors 767
- Fuselage Section 46 767
- Dorsal Fin 767
- Fuselage Section 46, 47 777–300

FHI (Fuji)
- Inboard/Outboard Spoilers 747–400
- Inboard/Outboard Aileron 747–400
- Elevator 737–600/–700/–800/–900
- Wing Stub Sec 11 777–200
- Wing Body Fairings 777–200
- Main Landing Gear Doors 777–200
- Body Fairing, Main Landing Gear Doors 767, 777–300
- Wing Stub Sec 11 777–300
- Outboard TE Flap 757–200/–300

KHI (Kawasaki)
- Outboard TE Flaps 747–400
- Wing Ribs 737–600/–700/–800/–900
- Large/Small Cargo Door 777–200, 777–300
- Fuselage Sec 43, 45 777–200
- Keel Beam 777–200, 777–300
- Inspar Ribs 777–200
- Entry Service Doors 767
- Fuselage Section 43, 45 767
- Inspar Ribs 767
- Fuselage Section 43, 44, 45 777–300
- Section 48 Pressure Dome Bulkhead 777–300

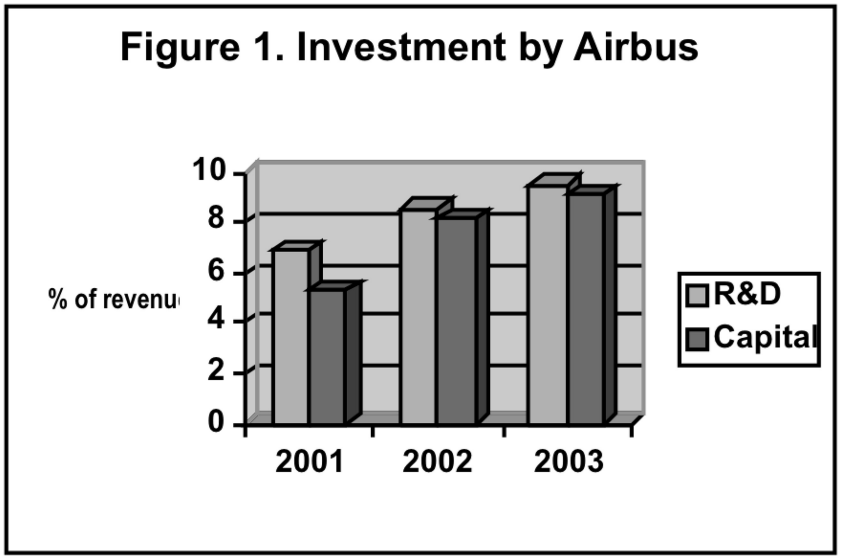
ShinMaywa Industries
- Elevators 717
- Elevator Tabs 717
- Horizontal Stabilizer 717
- Pylon 717

4. Boeing's Growing Dependency on Japan

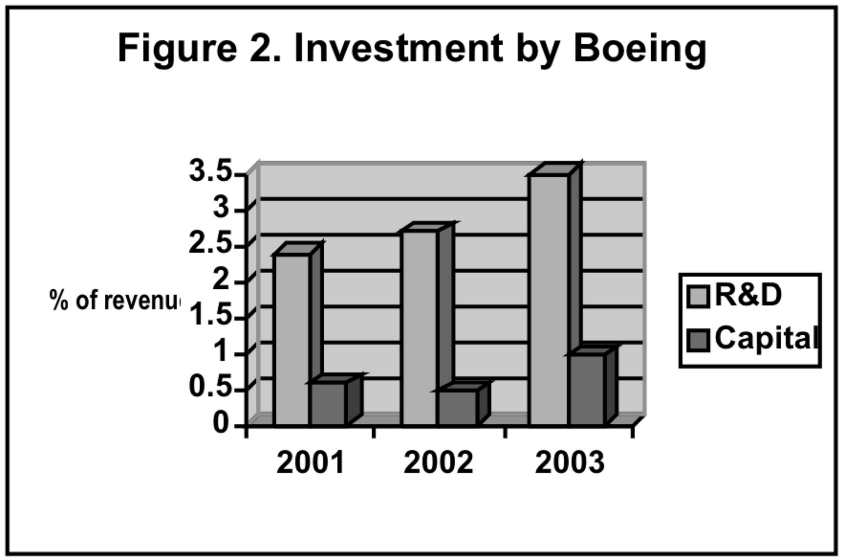
Japan's technological leadership in composites is one reason that Boeing is going to contract 35 percent of the 787-airframe structures to Japan. In an interview with Paul Lagace, MIT Professor of Aeronautics & Astronautics and Engineering Systems, "the United States lags behind Japan, Spain and Russia in aircraft composite technology" (Lagace, 2004). Boeing's airframes have changed very little since the introduction of the 747. With Airbus introducing major technological advances over a relatively short corporate lifetime, Boeing has been forced to move into this all composite aircraft. In the past, when Boeing was the world's leader in commercial aircraft manufacturing, it rested on its position in the industry and did not invest heavily in research and development for its commercial product line.

A further cause for concern is that Boeing has been trailing Airbus for many years with regard to R&D spending and capital investment (see Figures 1 and 2). In 2003, for example, Airbus allocated 9.5 percent of its total revenues toward R&D, compared to 3.5 percent for Boeing. In the same year, Boeing allocated only 0.97 percent of its total revenues to capital investment, compared to 9.1 percent for Airbus. While these percentages will no doubt increase as the A380 and 787 programs unfold, the fact that Boeing has underinvested for so long suggests that the 'catch-up' game in technological and engineering terms will be difficult to play. This decline dismantles U.S. technological and manufacturing communities from within, eroding the network of relationships, expertise and authority developed over decades (Sorscher, 2004).

Boeing is looking to leapfrog Airbus on composite technologies for the 787 aircraft. The strategic goal of "low technological risk and low financial exposure" makes it logical to partner with JADC's composite leaders. For example, Boeing recently awarded a 12-year contract worth $3 billion to the Japanese firm Toray for the carbon-fiber composite material to be used on the 787 aircraft (Gates, 2004).



Source: Annual Reports. Note: peruse the vertical scales before making interpretations.



Source: Annual Reports. Note: peruse the vertical scales before making interpretations.

But this dependency on Japan should not come as a major surprise. Recent developments reflect a continuation of the concerns that were discussed in a 1994 monograph "High-Stakes Aviation" by the National Research Council. The authors interviewed Charles Wessner, Director of Technology and Innovation, National Academy Sciences in March 2004. Wessner's principal concern is that the 787 wing technology and larger composite structures being sourced to Japan will ultimately curtail U.S. innovation capability and compromise U.S. security interests (Wessner, 2004). Perhaps ironically, some of the advanced composite technologies and related processes developed by Boeing (McDonnell Douglas Commercial) under 1989–1997 NASA R&D funding (the $354 million Composite Wing Development Program), as well as some $54 million in NASA funding for the Composite Fuselage (1989–1996) along with funding under the Advanced Subsonic Program (1993–1998), will be delivered to the Japanese under the 787 program. It would seem that U.S. tax dollars that were originally spent to promote U.S. technology development will soon be indirectly employed to upgrade that manufacturing and materials handling capabilities of foreign companies.

5. Japan's New Strategies for the Boeing 787

The technology and process improvements required for the 787 go far beyond raw material requirements (composites). Boeing's partners in Japan will be building composite structures that are stuffed with sub-systems that are already certified, tested and ready for final assembly. There will be minimum work content for the less than 1,000 Boeing Everett workers on the 787 program. The economic impact for the Japanese aircraft industry will have major multiplier effects, with the three Japanese 'heavies' in control of second and third tier supplier selection. The spread of subcontracts for the Japanese airframe manufacturers might add as many as 75 Japanese sub-tier suppliers. This does not include the estimated 60 second-tier Japanese engine, equipment and material suppliers, which can could add a further 100 third-tier Japanese suppliers.

The development of Japanese aerospace industrial base does not come without a price. Boeing has not finalized its program contracts with the Japanese companies (MHI, FHI and KHI) due to the definition of design and build responsibility. Early on in the program, Boeing envisioned that the Japanese would sign on as risk-sharing partners. In light of uncertainties regarding the Japanese government's funding scheme (uncertainties which have stemmed from WTO subsidy issues), as well as limited progress on securing first production article delivery schedules, no program contracts have been awarded.

In a recent article by Eamonn Fingleton, we find that: "in outsourcing the 787 wings, Boeing is crossing an economic Rubicon . . . no Boeing plane has ever flown on foreign wings" (Fingleton, 2005). Fingleton was questioning Boeing's judgment on transferring closely guarded wing-making technology to the Japanese. He further went on to assert that "wing-making is one of the most advanced sub-sectors of one of the world's most advanced manufacturing industries." Boeing responded to this criticism by stating that "when it came time to build the 787 wings, Boeing didn't have the machines and tools to build the wing box out of the carbon-fiber composites that will make the majority of the wing." (Corliss, 2005). The flaw in Boeing's argument is that Japan did not have the machines or tools either. In fact, the Japanese companies are only now purchasing hundred of millions of dollars in all new composite automatic tape layering machines, tooling, and autoclaves to meet the 787 structure sizes and production rate requirements. This reinforces already existing fears that Boeing will not invest in its future with major upgrades in terms of capital equipment or infrastructure. While the Japanese are building new facilities to produce the 787 wing and airframe, Boeing is simply reorganizing space inside its existing Everett facility to make space for the 3 day 787 final assembly activity.

6. Japan's 787 Funding and WTO Issues

The Japanese government's funding package for the 787 has been delayed several times since the first framework was announced in March 2004. The previous Japanese government international funding schemes for the Boeing 767 and 777 aircraft programs would be ruled illegal under today's 1994 WTO Agreement on Subsidies and Countervailing Measures (SCM Agreement). We are estimating that the Japanese government support for the 787 development will be $1,588 million, which is likely to be split 30% non-repayable grants and 70% in repayable loans (Pritchard and MacPherson, 2004A). Such a scheme is attractive because it provides market and development risk mitigation for the 787. Ultimately it lowers manufacturing costs of Japanese suppliers. These cost savings, which are subsequently passed through to Boeing can then be translated in lower prices in the marketplace.

In late 2004 it seemed that the Japanese government-funding scheme was being delayed because of the introduction of a repayment scheme (royalty-based loans) per wing-set delivered from first production delivery. On previous schemes, for the 767 and 777, Japanese government financing allowed Japanese industrial partners to Boeing to make a profit before making any loan repayments to the government (typically the delivery of the 500th ship set on 2,000 production run). This proposed change would not allow the JADC companies to have time to recover their own funding before the repayment of the Japanese government loans.

It is interesting to note that the current WTO dispute between EU and U.S. Governments concerns precisely this kind of 'launch aid' subsidy. The U.S. Government is complaining that EU governments subsidize Airbus through royalty-based loans. Ironically it seems that whilst Boeing complains about this system being used by its competitor, it is happy to see the same or an even more generous system used by its Japanese suppliers to reduce its own manufacturing costs for the 787. If the U.S. Government is successful in stopping the EU system through WTO litigation, this will probably result in Boeing also suffering from similar sanctions applied to the Japanese system.

If these low interest loans were not available to Japanese risk-sharing partners, it might be necessary for the Japanese companies to forgo the Japanese government-funding scheme and obtain loans from their own banks. However in early 2005 it now seems that the JADC has elected to apply to the Japanese government for loans of up to $1.5 billion and these loans will be granted.

As these loans so similar to the EU loans to Airbus, if the EU–U.S. fail to agree on a revised framework for the 1992 EU–U.S. aircraft agreement, the probability of the EU filing a WTO complaint on Japanese 787 subsidies seems likely.

This filing could have short and long term ramifications for Japan's capabilities for producing composite aircraft. In the short term, one could speculate the EU/WTO complaint on the 787 could have two probable outcomes. First, the Japanese government could halt any future payment to the JADC which would at the very least delay the 787 first delivery by at least a year while the Japanese heavies search the financial community for $3 billion of funding to support the 787 program (see Table 2). Secondly, the 787 WTO case could take up to 4 years to get resolved, during which the Japanese government continues to fund the 787 program and deal with the WTO decision after most of the money has been transferred to JADC. The longer-term ramifications would be that a delayed 787 program (could be up to two years) by a EU WTO filing could cause 787 risk-sharing partners and suppliers to lose their appetite for this type of financial exposure.

Table 2. Japan's 787 Investments

Companies	Components	Investment
MHI	Wing and Engines	$900
FHI	Airframe	$400
KHI	Airframe and Engines	$650
IHI	Engines	$350
ShinMaywa	Airframe	$150
Toray	Composite material	$250
Second Tier suppliers	Equipment and systems	$300
	Total Investment (millions)	$3,000

On a traditional Boeing aircraft launch, the program schedule would have key suppliers and critical path equipment contracted within the first 90 days, but the 787 still does not have its first-tier Japanese airframe partners contracted as of February 2005. This 7-month delay in all likelihood reflects problematic program funding along with incomplete agreement regarding design and build responsibility between Boeing and the JADC. After contracting the Japanese first-tier airframe partners in the first half of 2005, Boeing has an approximately 24-month window before the first scheduled 787 flight. Coupled with the fact that this is a very complex exercise in international systems integration, the aggressive first flight target date of mid 2007 may prove to be difficult to meet.

Implications

In the future, new western produced large commercial aircraft will be made of composites, while the traditional metal wing and tube aircraft (less than 150 seats) will be increasingly produced in the emerging regions (triad) of Russia, China, and India. With Boeing transferring the golden key technologies of the wing and the development of large composite airframe structures to Japan, the Japanese will have final pieces of technologies to produce their own aircraft. Mitsubishi Heavy Industries certainly has a clear vision on where the new aircraft composite technology for the 787 can lead them in the future. Junichi Maezawa, Executive Director of MHI, said that the "7e7 (now renamed the 787) is a cornerstone for Japan to become a stand-alone aircraft manufacturer in producing a 30 to 50 seater aircraft in a few years" (Shimbun, A 2004). At first, the most probable model will be an all-composite regional jet (threat to Bombardier and Embraer), followed by mid-size aircraft. Some industry experts believe the next generation 737 (an all-composite replacement) will be totally produced in Japan. So, with the technology and innovations being developed overseas, where does this leave the existing U.S. supplier base and the nation's future engineering capability? The average U.S. aerospace worker is 49 years old. With the tens of thousands of layoffs from Boeing in the past 4 years, there are few young workers to pass the technological and tribal knowledge for designing and manufacturing commercial aircraft. The result is a threat to the technical and economic security of the West where the integration capabilities exist. Regarding the retention of aircraft-related technological expertise inside the U.S., an interviewee from MIT (Paul Lagace) noted that: "you can't expect a private corporation to hold this responsibility, a national policy should be developed" (Lagace, 2004). A similar concern for long term technology and innovation (tribal knowledge) retention was voiced by Mark Tuttle, Professor of Mechanical Engineering at the University of Washington in a March 2004 interview (Tuttle, 2004). Jacques Tournut, Director of the Aerospace Program at the Toulouse Business School, in a March 2004 interview, went on to question the wisdom of transferring the critical wing design and manufacturing technology for the 787 outside the company's control to a risk sharing partner (Tournut, 2004).

Boeing's product line is rapidly aging, with 4 of the 6 commercial product lines projected to close in the next few years (717, 757, 767 and 747). This leaves only the 737 and 777 in production until the 787 comes on line. One has to question

whether the 787 is too late in arriving to save the Boeing commercial product line. In the future, moreover, will Boeing and foreign partners be willing to invest enormous sums of money to keep developing aircraft models? This is illustrated by a statement from Sir Richard Evans, the outgoing chairman of BAE, who estimated Boeing would need to spend between $40 to $50 billion over the next 10–15 years to "match" Airbus's product range (Odell, 2004).

In light of the scenarios and trends discussed above, it is no surprise that the U.S. Bureau of Labor Statistics (2004) has a number of dismal forecasts for employment and occupational change within the U.S. commercial aircraft industry. As mentioned at the start of this paper, the overall employment forecast over 2002–2012 is for a 17.6 percent decrease. At the level of specific occupations, the forecasts are even more revealing. Specific examples include machinists (−22%), machine tool cutting setters (−24.2%), assemblers and fabricators (−24.7%), aerospace engineers (−15.8%), mechanical engineers (−21.5%), and industrial engineers (−15.8%). These are the people that design and build commercial aircraft. While some of these projected losses will surely come as a result of increased process automation (rising productivity) or retirements, just as they have in the past, the growth of international outsourcing is surely an important factor as well.

Summary and Conclusion

For Boeing, the launch of a new aircraft program based on systems integration makes good sense in terms of risk reduction, the containment of launch costs, and the acquisition of advanced composites. But the financial advantages need to be balanced against broader economic and strategic concerns, including the rapid erosion of the U.S. supplier base, the possibility that Japan may eventually become a U.S./EU competitor with its own stand-alone aircraft program and a low-cost Asian supplier network, and the fact that rising levels of foreign content ultimately contravene the interests of U.S. workers in skilled occupations. In the past, Boeing's foreign subcontractors supplied relatively simple components (bits and pieces). More recently, these subcontractors have been asked to design, develop, and build complex parts of the airframe (e.g. wing assemblies). Airbus, in contrast, keeps final wing assembly work almost 100% in-house (as well as other complex systems).

It could be argued that the future of Boeing's presence in the commercial aircraft business, as well as the income security of its diminishing workforce, hinges in large part on the success of the 787 program. Based on Boeing's "system integration" model one could envision within 10 years that all of Boeing's commercial aircraft could be downsized to a single site in Everett, Washington. This is reinforced by the recent agreement to sell the Boeing Wichita commercial division to the Onex Corporation, a Canadian company. After the Wichita sale, the only major part of the 787 to be made by Boeing will be the tailfin (the rudder is subcontracted to China).

The U.S. commercial aircraft industry was vibrant in the 1960s, with three commercial aircraft manufacturers (Boeing, Douglas and Lockheed) and thousands of U.S. sub-tier suppliers spread across the United States employing hundreds of thousands of people. Now with Boeing in the final throws of dismantling this industry, one could foresee only a couple of thousand workers in the Everett Plant conducting a 3 day final assembly process for the 787, 737 replacement and a reconfigured 777 production line supported mainly by foreign controlled supply chains. For the first time in U.S. commercial aviation history, a new aircraft launch has been structured in a fashion that gives foreign partners the control over design, manufacturing, subtier supplier selection and, ultimately, the financial muscle to destroy what little remains of the U.S. commercial aircraft industry.

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Final Report

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Executive Summary

WHAT IS GLOBALIZATION?

Globalization—the integration of the political, economic and cultural activities of geographically and/or nationally separated peoples—is not a discernible event or challenge, is not new, but it is accelerating. More importantly, globalization is largely irresistible. Thus, globalization is not a policy option, but a fact to which policymakers must adapt.

Globalization has accelerated as a result of many positive factors, the most notable of which include: the collapse of communism and the end of the Cold War; the spread of capitalism and free trade; more rapid and global capital flows and more liberal financial markets; the liberalization of communications; international academic and scientific collaboration; and faster and more efficient forms of transportation. At the core of accelerated global integration—at once its principal cause *and* consequence—is the information revolution, which is knocking down once-formidable barriers of physical distance, blurring national boundaries and creating cross-border communities of all types.

HOW DOES GLOBALIZATION AFFECT DOD?

Globalization affects DoD in two distinct, if overlapping, ways. First, it is altering fundamentally the composition of DoD's supporting industrial base while, in turn, necessitating a reengineering of DoD acquisition and business practices. Second, and perhaps more significantly, it is reshaping the military-technological environment in which DoD must compete. These twin trends present DoD with both opportunities for and challenges to the maintenance of global military dominance.

Globalization's Impact on DoD's Supporting Industrial Base

DoD once depended upon, and could afford to sustain, a dedicated domestic industrial base for the development, production and provision of its equipment and services. Today, the "U.S. defense industrial base" no longer exists in its Cold War form. Instead, DoD now is supported by a broader, less defense-intensive industrial base that is becoming increasingly *international* in character. This transformation is due largely to the confluence of four factors: (1) deep cuts in U.S. defense investment in the Cold War's wake (procurement and R&D are down 70 percent and 25 percent in real terms, respectively, since the late-1980s), (2) an explosion in commercial sector high-tech R&D investment and technological advancement, (3) a sustained DoD acquisition reform effort; and (4) a shift in procurement emphasis from weapons and platforms, per se, to the sophisticated information technologies so amplifying their capabilities.

Yesterday's U.S. defense industry is, with few exceptions, reconstituting itself into a global, more commercially-oriented industry. The traditional core of the defense industrial sector—those firms still focusing nearly exclusively on the defense market—comprises firms that will focus increasingly on the integration of commercially-developed advanced technology to produce military capabilities. That which remains of the traditional U.S. defense sector:

- has undergone an intense period of consolidation;
- has already begun—although mainly in the lower industrial tiers—the process of integration across national borders, via mergers, acquisitions, joint ventures and strategic partnerships with European counterparts, who are themselves in a period of rationalization and consolidation; and
- is now supplied to a significant degree by the commercial sector and is increasingly dependent on commercial business and defense product exports for growth and good health.

The commercial sector, which pays scant attention to national boundaries, is now driving the development of much of the advanced technology integrated into modern information-intensive military systems. This is especially true of the software and consumer microelectronics sectors. Accordingly, future U.S. military-technological advantage will derive less from advanced component and subsystem technology developed by the U.S. defense sector than from the military functionality generated by superior, though not necessarily U.S.-based, defense sector systems integration skills.

The economic and technological imperatives for increased DoD reliance on the commercial sector have also necessitated a reengineering of the Department's acquisition and business practices. Acquisition reform initiatives launched in the early 1990s had evolved by late 1997 into a broader, ongoing Defense Reform Initiative. The most striking aspect of DoD's business practice reengineering is the ongoing, Defense-wide transition to an all-electronic business operating environment. Within

just a few years, virtually all DoD business operations, and many critical military functions (e.g., logistics), will be conducted over the Internet and World Wide Web.

Benefits and Risks of Industrial Base Globalization

The potential benefits of globalization are many fold. Increased use of the commercial sector cannot be separated from the effects of globalization. Nor is increased DoD reliance on the commercial sector reversible without sacrificing the huge gains in capability achieved through rapid insertion of leading-edge commercial technology (particularly information-related), and comparable gains in efficiency through use of commercial services. Greater commercial reliance also has the potential to increase the pace of modernization by reducing system acquisition cycle time. The DoD experience of product development cycles for defense systems of 18 years contrasts sharply with much shorter such cycles for most commercial products.

Moreover, commercial acquisition could lower substantially the cost not only of new systems, but also of system upgrades and operational support. Indeed, the impact on DoD capabilities of the post-Cold War decline in defense resources has been manageable only through greater use of commercial products and services. Finally, the Department's adoption of "world-class" commercial business practices—enabled by the full exploitation of Internet-based information technologies—could enhance dramatically DoD's organizational efficiency and effectiveness. This could allow DoD to cut overhead costs and reinvest the savings in force modernization, and to improve its logistical support to the warfighter.

Cross-border defense industrial integration—and transatlantic links in particular—can help spread the fiscal burden of new system development and production and, from a U.S. perspective, facilitate greater access to our allies' technology and capital. Competition between transatlantic industrial teams—each consisting of both European and U.S. members—could yield innovative, high-quality products, and, for domicile governments, a greater return on defense investments. Such competition would likely stimulate innovation and create the incentive to adopt the industrial and acquisition-related efficiencies that generate downward pressure on system cost and acquisition cycle-time. Transatlantic defense industrial links are a potential source of greater political-military cohesion within NATO and of a stronger alliance industrial underpinning, and thus would help to promote more uniform modernization and thus enhance U.S.-European interoperability.

Such links could also amplify NATO fighting strength by enhancing U.S.-European interoperability and narrowing the U.S.-European technological gap. Perhaps most important, strong transatlantic industrial links could help DoD avert a distinctly negative outcome: the emergence of protectionist "Fortress Europe-Fortress America" defense trade blocs that could serve to widen the U.S.-European military-technological gap and weaken overall NATO integrity.

To be sure, there are risks to DoD in relying more heavily on a fully globalized commercial sector and on a transnational defense industrial base. On balance, however, the Task Force found these risks to be manageable and noted comparable vulnerabilities in DoD's traditional approach to defense procurement—reliance on a captive U.S. defense industry. But while the Task Force deemed the risks manageable, it recommends more aggressive and accountable management of those risks.

The Department's transition to an Internet-based business operating environment—designed in part to enhance civil-military integration—places most of DoD's digital activities and information within the cyber-reach of any and all who want to rapidly gather intelligence on the United States and/or who wish us harm. Such global interconnectivity could provide potential adversaries an open-source intelligence boon. Adversaries scanning DoD websites will likely exploit electronic data mining and aggregation capabilities to piece together rapidly and inexpensively information on U.S. capabilities, operations and personnel that heretofore would have taken much more time, effort and resources to obtain.

Global interconnectivity can also provide adversaries an electronic penetration pathway into U.S. information systems to harm the confidentiality, integrity or availability of essential information and functionality. Such activities are now referred to broadly in national security parlance as information operations. The principal risk associated with commercial acquisition is that DoD's necessary, inevitable and ever-increasing reliance on commercial software—often developed offshore and/or by software engineers who owe little, if any allegiance to the United States—is likely amplifying DoD vulnerability to information operations against all systems incorporating such software.

Commercial software products—within which malicious code can be hidden—are becoming foundations of DoD's future command and control, weapons, logistics and business operational systems (e.g., contracting and weapon system support). Such malicious code, which would facilitate system intrusion, would be all but impossible

to detect through testing, primarily because of software's extreme and ever-increasing complexity. Of equal concern is the ubiquity of exploitable, though inadvertent, vulnerabilities in commercial software. In either case, the trend toward universal networking increases the risk. Inevitably, increased functionality means increased vulnerability.

Compounding matters, the current personnel security system is ill-configured to mitigate the growing information operations risks. The problems lie generally in the over-classification of information (which skews allocation of security resources), and the inherent limitations of the security clearance model (which provides little, if any, monitoring of personnel for five to 10 years after the clearance is granted). The current security model deals principally with the confidentiality of information, neglecting the integrity and availability of information and information systems.

Information technology has also outpaced some of the core concepts upon which the traditional DoD security system is based: the control of physical access, and the distinctions between classified and unclassified information. Security programs have focused on the control of physical access to information and materials, because the spies of the past generally have exploited their physical access to the material they wanted to compromise. However, the practices and tools of physical access control (e.g., access to facilities, controlled areas, or photocopiers) are ineffective against the remote cyber-spy and trusted insider cyber-traitor. The current personnel security system also tends to focus primarily on classified information and activities. It is clear today, however, that the classified world is not the only one with a security requirement. DoD has a number of unclassified systems that are, in every sense, "mission critical" (e.g., wartime blood supply management networks) yet essentially unprotected by the existing security system.

The traditional risk associated with cross-border defense industrial integration is the unauthorized or unintended direct or third-party transfer of "sensitive" U.S. military technology. However, the strong compliance record of foreign-owned, controlled or influenced (FOCI) firms operating in the U.S. under DoD security agreements (e.g., Security Control Agreements, Special Security Agreements, Voting Trusts, or Proxy Board Agreements) indicates that the risks are manageable. Several U.S. Government studies, in fact, conclude that our risk mitigation measures have been very successful. Indeed, the evidence shows that regulatory compliance has been of a higher order for domestic subsidiaries of foreign parents than for domestic firms. To be sure, unauthorized technology transfer is a serious problem. Yet, it is a longstanding and, in all likelihood, enduring one that comes from all azimuths, including U.S. citizens cleared to the highest levels and legitimate exports. So long as the established security mechanisms are in place, the risk of unauthorized disclosure can be mitigated, if imperfectly.

Beyond unauthorized technology transfer, the risks associated with cross-border defense linkages are less clear-cut. To the extent that foreign direct investment in the U.S. defense sector leads to the offshore relocation of domestic development and manufacturing facilities, it could result in the erosion of certain domestic defense industrial skills. There is legitimate concern about potential disruptions in the supply of critical components or subsystems should sole industrial sources for such articles move offshore or come under foreign ownership. And, there is a related concern about potential loss of DoD influence over weapon system design should cross-border consolidation result in a very few large transnational firms selling to dozens of major buying nations (thus reducing DoD's market share). The Task Force examined these potential risks, but found none of them new, nor compelling when cast against the potential benefits of transnational defense industrial integration.

Globalization's Impact on the International Military-Technological Environment

From a long-term strategic standpoint, globalization's most significant manifestation is the irresistible leveling effect it is having on the international military-technological environment in which DoD must compete. Over time, all states—not just the U.S. and its allies—will share access to much of the technology underpinning the modern military.

The international conventional arms market, once driven mainly by political imperatives, is now driven increasingly by economic imperatives. This is perhaps less true of the United States—the Arms Export Control Act requires conventional arms transfers to be consistent with U.S. foreign policy and national security objectives—but the U.S. defense sector is far from immune to the trend. The economic pressure on firms to export, combined with their governments' willingness to let them do so and with the increasing level of cross-border collaboration, will progressively erode the effectiveness of conventional arms and defense technology export controls worldwide. When combined with the black and gray market availability of most types of

defense products, and the pressure on already export-minded firms to offer their most sophisticated equipment, these trends suggest that, with few exceptions, advanced conventional weapons will be available to anyone who can afford them.

The technology DoD is most anticipating leveraging to maintain military dominance is that which the United States is *least* capable of denying its potential competitors. Access to commercial technology is virtually universal, and its exploitation for both civil and military ends is largely unconstrained. The most important enabling technologies for information-intensive U.S. concepts of warfare—access to space, surveillance, sensors and signal processing, high fidelity simulation, and telecommunications—are available to the U.S., its allies, and its adversaries alike. Indeed, owing to the proliferation of military technology, the commercialization of former military-specific technology, and the increasing reliance of militaries worldwide on commercially-developed technology, and the general diffusion of technology and know-how, *the majority of militarily useful technology is or eventually will be available commercially and/or from non-U.S. defense companies*. The so-called "Revolution in Military Affairs" is, at least from a technology availability standpoint, truly a global affair.

Potential competitors are exploiting their newfound access to militarily useful technology in a manner strategically detrimental to DoD. They are not trying to match U.S. strengths or achieve across the board military parity with the United States. Rather, as several recent DSB Summer Studies have pointed out, potential competitors are channeling their more limited defense resources into widely-available capabilities that could allow them to exploit a fundamental weakness of American power projection strategy: the absolute reliance of most U.S. forces on unimpeded, unrestricted access to and use of theater ports, bases, airfields, airspace and coastal waters. By 2010–2020, potential adversaries, exploiting a truly global military-technical revolution, will likely have developed robust capabilities—conventional and unconventional—for disrupting U.S. homeland preparations to deploy to the theater of conflict; denying U.S. forces access to the theater; degrading the capabilities of the forces the U.S. does manage to deploy; and, in the process, raising, perhaps prohibitively, the cost of U.S. intervention. In short, technological leveling—globalization's most strategically unsettling manifestation from a U.S. perspective—is clearly the engine of the emerging "anti-access" threat.

Consequently, there is growing risk inherent in U.S. power projection and force modernization strategy. Left unchecked, this may lead to a decline in the U.S. military's utility for influencing events abroad or protecting U.S. global interests at acceptable cost—a serious erosion of military dominance. At the root of the problem are the inherent limitations—namely, sluggish deployment times and heavy dependence on theater access—of the legacy, primarily short-range, general-purpose force elements to which the vast majority of the Services' modernization funding is currently dedicated. *Viewed in this light, the continued budgetary, strategic and force structuring primacy of legacy systems in DoD budgets has a clear and high opportunity cost: the investment agility necessary to transform U.S. strategy and forces to meet the emerging strategic challenges posed by global military-technological leveling*.

Compounding this problem are the continuing declines in DoD research, development, test and evaluation (RDT&E) and defense industry internal research and development (IR&D) spending, and the related skewing of such R&D investment toward near-term priorities and away from fundamentally new capabilities. The result is severely depressed U.S. military-technological innovation at a time when the premium on innovation has never been higher.

Theoretically, the U.S. could mitigate the undesirable effects of global military-technological leveling by coordinating with its allies the multilateral control of conventional military and dual-use technology exports. This approach worked reasonably well during the Cold War through the Coordinating Committee on Export Controls (CoCom). However, multilateral controls today are no longer a significant factor affecting access to highly sophisticated dual-use technology and they have been only marginally more successful in the conventional weapons arena. CoCom's success derived from its members facing a common threat—the Warsaw Pact and, to a lesser extent, China—and sharing a common objective: retarding Warsaw Pact and Chinese technological advancement. CoCom also benefited from the disproportionate leverage the United States, its leading advocate, held over the other members as the guarantor of Western security. The Cold War's end undermined this cooperative impetus, and the U.S. can no longer count on its allies, its closest competitors in the high-tech sector, to follow America's lead. The lukewarm success of CoCom's successor, the Wassenaar Arrangement, is a testament to the declining utility of multilateral technology controls in the post-Cold War era.

The strategic significance of global military-technological leveling cannot be overstated. It presents a direct challenge to perhaps *the* fundamental, if subliminal, assumption underlying the modern—and certainly post-Cold War—concept of U.S. military superiority: that the United States enjoys disproportionately greater access to advanced technology than its potential adversaries. This assumption also underpins the logic holding that technology controls are the *sine qua non* of U.S. military dominance.

The reality is that the United States' capability to effectively deny its competitors access to militarily useful technology will likely decrease substantially over the long-term. Export controls on U.S. technologies, products and services with defense/dual-use applications will continue to play a role in the pursuit of U.S. foreign policy objectives. However, the utility of export controls as a tool for maintaining the United States' global military advantage is diminishing as the number of U.S.-controllable militarily useful technologies shrinks. A failure by U.S. leadership to recognize this fundamental shift—particularly if masked by unwarranted confidence in broad or even country-specific export controls—could foster a false sense of security as potential adversaries arm themselves with available technology functionally equivalent to or better than our own.

Clinging to a failing policy of export controls has undesirable consequences beyond self-delusion. It can limit the special influence the U.S. might otherwise accrue as a global provider and supporter of military equipment and services. This obviously includes useful knowledge of, and access to, competitor military systems that only the supplier would have, and the ability to withhold training, spares, and support. Equally obvious, shutting U.S. companies out of markets served instead by foreign firms will weaken the U.S. commercial advanced technology and defense sectors upon which U.S. economic security and military-technical advantage depend.

KEY TASK FORCE RECOMMENDATIONS

DoD has not been aggressive in capturing the benefits of or mitigating the risks posed by globalization. Change has come slowly due to a range of factors, including cultural impediments, legal and regulatory obstacles, and restrictive and unclear policies. The Department needs to change the way it does business in a number of areas:

The Department needs a new approach to maintaining military dominance

Globalization is irresistibly eroding the military advantage the U.S. has long sought to derive through technology controls. Accordingly, the more the United States depends on technology controls for maintaining the capability gap between its military forces and those of its competitors, the greater the likelihood that gap will narrow. To hedge against this risk, DoD's strategy for achieving and maintaining military dominance must be rooted firmly in the awareness that technology controls ultimately will not succeed in denying its competitors access to militarily useful technology.

DoD must shift its overall approach to military dominance from "protecting" militarily-relevant technologies—the building blocks of military capability—to "preserving" in the face of globalization those military capabilities essential to meeting national military objectives. Protection would play a role in an overall strategy for preserving essential capabilities, but its primacy would be supplanted by three other strategy elements: direct capability enhancement, institutionalized vulnerability analysis and assessment, and risk mitigation efforts designed to ensure system integrity.

To shift its approach from *technology protection* to essential *capability preservation*, the Task Force recommends that DoD: (1) establish a permanent process for determining a continuously-evolving "short list" of essential military capabilities, and (2) develop strategies for preserving each essential capability. Both the list of essential military capabilities and the strategies for their preservation are needed to inform the development of: U.S. warfighting strategy and the forces to underpin that strategy (by identifying how and with what the U.S. will need to fight to remain dominant), DoD positions on technology and personnel security (by helping to identify those capabilities and/or constituent technologies which DoD should attempt to protect and how vigorously they should be protected); and DoD acquisition risk mitigation measures (by identifying those systems that should be the focus of intense efforts to ensure system integrity).

DoD needs to change substantially its approach to technology security

The United States has a national approach to technology security, one in which the Departments of State and Defense both play essential roles. The Task Force does not challenge the propriety of the Department of State's statutory obligation to evaluate proposed defense technology transfers against U.S. foreign policy objec-

tives. That said, the leveling of the global military-technological playing field also necessitates a substantial shift in *DoD's* approach to technology security, the principal objective of which is to help maintain the U.S. military-technical advantage.

DoD should attempt to protect for the purposes of maintaining military advantage only those capabilities and technologies of which the U.S. is the sole possessor and whose protection is deemed necessary to preserve an essential military capability. Protection of capabilities and technologies readily available on the world market is, at best, unhelpful to the maintenance of military dominance and, at worst, counterproductive (e.g., by undermining the industry upon which U.S. military-technological supremacy depends). Where there is foreign availability of technologies, a decision to transfer need only be made on foreign policy grounds by the Department of State. DoD should no longer review export license applications as part of its role in the arms transfer process when foreign availability has been established. This will allow the DoD licensing review to concentrate on cases where the availability of technology is exclusive to the United States.

Moreover, military capability is created when widely available and/or defense-unique technologies are *integrated* into a defense system. Accordingly, DoD should give highest priority in its technology security efforts to technology integration capabilities and the resulting military capabilities themselves, and accordingly lower priority to the individual technologies of which they are comprised.

For those items and/or information that DoD can and should protect, the Task Force believes security measures need improvement. The means for such an improvement might come from a redistribution of the current level of security resources/effort, whereby DoD relaxes security in less important areas and tightens up in those most critical. In short, DoD must put up higher walls around a much smaller group of capabilities and technologies.

DoD must realize fully the potential of the commercial sector to meets its needs

To leverage fully the commercial sector, DoD must do more than simply acquire available commercial products and adopt commercial practices. In some cases, DoD must engage commercial industry in an effort to shape the development of new products and services to better meet its needs. In many cases, DoD must adapt its often-bloated system requirements to, and develop new concepts that fit, operationally acceptable commercial solutions. The Task Force makes two primary recommendations designed to help DoD meet this overarching objective.

First, the Secretary of Defense should give commercial acquisition primacy and broader scope by establishing it as the modernization instrument of first resort. DoD should seek to meet its modernization needs, whenever possible, with commercial solutions (including integrated services, systems, subsystems, components and building-block technologies) acquired using commercial acquisition practices. The Secretary should grant waivers to the acquisition of commercial *products and services* only when program managers can demonstrate that either no commercial options exist or that available commercial options cannot meet all critical performance requirements. DoD should employ commercial acquisition *practices* in all cases. The Task Force recognizes that some integrated, military-specific systems (e.g., precision-guided munitions and combat aircraft) are not and will likely never be provided by the commercial sector. Even here, DoD should meet its needs, whenever possible, with commercial components and subsystems. DoD can and should tap the commercial market to support virtually all of its modernization requirements.

Second, the Under Secretary of Defense for Acquisition and Technology should form and routinely employ "Commercial Acquisition Gold Teams" to provide and manage advocacy for expanded DoD leverage of the commercial sector. The Task Force believes that Gold Teams should be employed during the earliest stages of the acquisition process (the concept definition phase), where they will have the best opportunity to reduce both the time and cost of developing and fielding new systems. Gold Teams should be focused initially on the commercial industry sectors from which the Task Force believes DoD can derive immediate and profound benefit: air and sea transportation; logistics and sustainment; communications and information systems; space-based surveillance; and high-efficiency ground transportation. The organizational character and composition of the Commercial Acquisition Gold Teams are best determined by the USD(A&T). Teams could be either standing or *ad hoc* in character. Personnel could be either in-house (i.e., DoD), drawn from the contractor/FFRDC community, or a mix of the two.

In addition to these two core recommendations, DoD must also: (1) engage proactively in commercial standards management; (2) conduct a comprehensive review of the Federal Acquisition Regulations (FAR) and Defense Federal Acquisition Regulations Supplement (DFARS) with the intent of asking Congress to eliminate

remaining statutory barriers to DoD procurement of commercial products and services and also commercial sector disincentives for doing business with DoD; and (3) field on the World Wide Web interactive "distance-learning" software that would allow commercial firms to quickly familiarize themselves with the FAR/DFARS; rapidly determine which regulations apply to their specific contracts; and comply fully with those regulations.

DoD should take the lead in establishing and maintaining a real-time, interagency database of globally available, militarily relevant technologies and capabilities

Such a database, which would facilitate rapid and authoritative determination of the foreign availability of a particular technology or military capability, would serve two principal functions. First, it would allow those involved in the export licensing and arms transfer decisionmaking process to determine which technologies and capabilities are available abroad and thus no longer U.S.-controllable. Second, it would facilitate enhanced access by U.S. Government and industry weapons developers to the global technological marketplace by illuminating potential foreign sources and/or collaborators.

DoD must ensure the integrity of essential software-intensive systems

With DoD's growing reliance on commercial software increasing its vulnerability to information operations, the Department must redouble its efforts to ensure the integrity of essential software-intensive systems. To this end, the Task Force makes two primary recommendations. First, the Secretary of Defense should affirm the Assistant Secretary of Defense (Command, Control, Communications and Intelligence) as responsible for ensuring the pre-operational integrity of essential software-intensive systems. In turn, the ASD(C3I) should develop and promulgate an Essential System Software Assurance Program which:

- identifies a point organization for software acquisition review to promote the purchase of commercial software while monitoring its vulnerabilities;
- identifies unambiguously the point in the acquisition process where a system's operator should assume responsibility for its integrity throughout its operational life;
- updates guidance concerning program managers' software integrity assurance responsibilities and declare such integrity a Key Performance Parameter (KPP);
- considers the "clean room" acquisition of certain essential systems or subsystems (i.e., one-hundred percent DoD-controlled system development and production);
- introduces "red-teaming" and independent vulnerability analysis procedures into the acquisition process for all essential systems;
- develops specifications and guidelines for the certification of software trustworthiness at a set of pre-defined levels;
- sponsors research at DARPA and NIST on trust certification and management in software, software design methodology, proof of software correctness, taxonomy of vulnerability, and smart (if non-exhaustive) testing; and
- considers using public (hacker) testing to test algorithm, code and system resilience.

Second, the Secretary of Defense should reaffirm the responsibility of essential system operators to ensure the integrity of those systems throughout their operational life, and assign to the OASD(C3I) Defense Information Assurance Program (DIAP) office the tasks of monitoring and establishing incentives to ensure operator compliance, and of overseeing the administration of the resources required for this purpose. The OASD(C3I) DIAP office should be upgraded (in terms of personnel, equipment and funding) and assigned the full responsibility of overseeing program office/operator identification, programming and execution of the required resources, and of submitting a consolidated information assurance budget. In turn, the operators should:

- ensure that intrusion and anomaly detection systems are in place, current, and operating at peak efficiency;
- ensure that sufficient excess capacity is available to counter expected denial-of-service attacks, and/or that other measures are taken to improve recovery and reconstitution of essential systems;
- ensure that systems originally intended as independent backups are still independent given changes in technology and threat by using dedicated vulnerability-analysis "red" teams;
- ensure adequate configuration control of essential systems; and

- deny unauthorized access—using physical, technical and personnel security measures.

The Task Force also recommends that DoD: (1) expand its red-teaming and vulnerability-assessment capabilities; (2) ensure a sufficiently staffed, trained, and motivated workforce to acquire and operate essential systems; and (3) enhance security and counter-intelligence programs to deal with the new challenges presented by relying on commercially purchased systems and subsystems of foreign manufacture.

DoD should facilitate transnational defense industrial collaboration and integration

Greater transnational, and particularly transatlantic, defense-industrial integration could potentially yield tremendous benefit to the United States and its allies. The Task Force, however, identified a range of factors working to inhibit foreign industrial interest in greater integration with their U.S. counterparts. These include insufficient clarity in DoD policy on cross-border defense industrial mergers and acquisitions, and an overly burdensome regulatory environment surrounding both foreign direct investment in the U.S. defense sector and the transfer of U.S. defense technology, products and services.

The Task Force makes three principal recommendations to erode these barriers to effective defense sector globalization. First, DoD should publicly reaffirm, on a recurring basis, its willingness to consider a range of cross-border defense industrial linkages that enhance U.S. security, interoperability with potential coalition partners, and competition in defense markets. Special attention should be paid to illuminating—to the extent practicable—DoD's broad criteria for merger and acquisition approval, and DoD's policy rationale (e.g., the national security benefits of cross-border defense consolidation). Second, the Department of Defense should engage the Department of State to jointly modernize the regulatory regime and associated administrative processes affecting the export of U.S. defense articles. Third, DoD should also modernize the administrative and regulatory processes associated with foreign direct investment (FDI) to facilitate FDI in the U.S. defense sector.

The Task Force also recommends that DoD adapt existing bilateral industrial security arrangements to respond to the emergence of multinational foreign defense industrial organizations. The change in the structure of the defense industry raises a question about whether the existing security practices are appropriate to its inevitable globalization.

DoD needs to reform its personnel security system

Personnel security is the foundation upon which all other safeguards must rest. However, the Task Force is convinced that, with far more information than necessary being classified by the Original Classification Authorities, the DoD personnel security program is forced to sweep too broadly and is consequently spread thin. Over-classification also leads to an over-allocation of security resources to the protection of classified information at a time when greater resources must be devoted to developing new types of security measures tailored to the challenges created by global information technology. DoD should make a serious commitment to developing a coordinated analytic framework to serve as the basis for classifying information, and for implementing that framework rigorously.

DoD personnel security also depends too heavily on the security clearance process. The clearance process does provide a vital initial filter, weeding out individuals with criminal records or other conspicuously irresponsible conduct. Beyond that, however, its utility fades precipitously—a fact with which the Department must come to grips. Unrealistic expectations of the clearance process have inadvertently undermined the very alertness, accountability and situational awareness necessary for security in a networked world.

In the dynamic, networked environment created by global information technology, DoD needs to develop an enhanced situational awareness approach to personnel security that considers new vulnerabilities, threats, and response requirements. Emerging information technologies (e.g., near real-time data mining of financial and foreign travel databases) hold the seeds of effective defensive options. Compartmentation is also a valuable security instrument. DoD should place a premium on protecting information that is properly determined to require control in codeword compartments. Also needed is an appropriate security program for government and defense industry personnel who occupy "sensitive but unclassified" information technology positions (e.g., those critical for protecting information systems from hostile disruption or manipulation via the global information infrastructure). Here, monitoring on-the-job performance may be more important than full field background investigations.

In the information age, no single set of personnel security countermeasures will suffice; DoD must achieve a complementary mix of technical, procedural, human resources management and traditional personnel security measures. To this end, the Task Force recommends that DoD:

- Adapt its personnel security system to the information age by streamlining the security classification and clearance processes; ensuring that classifications are justified to mitigate the problem of over-classification; and moving away from a rigid clearance structure.
- Compartmentalize its most sensitive information and activities by restoring the "need to know" principle for classified data stored on electronic systems (taking advantage of security, privacy and intellectual property rights management developments in the e-commerce sector.)
- Institute a situational awareness approach to personnel security combining technical monitoring and human resources management tailored to positions presenting the greatest risks and vulnerabilities.
- Develop a new situational awareness program for personnel in sensitive (classified and unclassified) information technology positions.
- Work with the Intelligence Community to develop more effective situational awareness measures to address the insider threat at the classified level, making greater use of outside research and independent threat/vulnerability evaluation.

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Globalization brings with it opportunity and risk. Boldness is required to meet this challenge and to capture the benefits of globalization while mitigating its risks. Leadership is the key. Success will hinge on DoD's ability to establish clear policy guidance that is understood within the Department and across U.S. Government agencies, in the Congress, in U.S. industry, and by allies and friends abroad.

STATUTORY MANDATE OF THE U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

Pursuant to Public Law 108–7, Division P, enacted February 20, 2003

RESPONSIBILITIES OF THE COMMISSION.—The United States-China Commission shall focus, in lieu of any other areas of work or study, on the following:

PROLIFERATION PRACTICES.—The Commission shall analyze and assess the Chinese role in the proliferation of weapons of mass destruction and other weapons (including dual use technologies) to terrorist-sponsoring states, and suggest possible steps which the United States might take, including economic sanctions, to encourage the Chinese to stop such practices.

ECONOMIC REFORMS AND UNITED STATES ECONOMIC TRANSFERS.—The Commission shall analyze and assess the qualitative and quantitative nature of the shift of United States production activities to China, including the relocation of high-technology, manufacturing, and R&D facilities; the impact of these transfers on United States national security, including political influence by the Chinese Government over American firms, dependence of the United States national security industrial base on Chinese imports, the adequacy of United States export control laws, and the effect of these transfers on United States economic security, employment, and the standard of living of the American people; analyze China's national budget and assess China's fiscal strength to address internal instability problems and assess the likelihood of externalization of such problems.

ENERGY.—The Commission shall evaluate and assess how China's large and growing economy will impact upon world energy supplies and the role the United States can play, including joint R&D efforts and technological assistance, in influencing China's energy policy.

UNITED STATES CAPITAL MARKETS.—The Commission shall evaluate the extent of Chinese access to, and use of United States capital markets, and whether the existing disclosure and transparency rules are adequate to identify Chinese companies which are active in United States markets and are also engaged in proliferation activities or other activities harmful to United States security interests.

CORPORATE REPORTING.—The Commission shall assess United States trade and investment relationship with China, including the need for corporate reporting on United States investments in China and incentives that China may be offering to United States corporations to relocate production and R&D to China.

REGIONAL ECONOMIC AND SECURITY IMPACTS.—The Commission shall assess the extent of China's "hollowing-out" of Asian manufacturing economies, and the impact on United States economic and security interests in the region; review the triangular economic and security relationship among the United States, Taipei and Beijing, including Beijing's military modernization and force deployments aimed at Taipei, and the adequacy of United States executive branch coordination and consultation with Congress on United States arms sales and defense relationship with Taipei.

UNITED STATES-CHINA BILATERAL PROGRAMS.—The Commission shall assess science and technology programs to evaluate if the United States is developing an adequate coordinating mechanism with appropriate review by the intelligence community with Congress; assess the degree of non-compliance by China and [with] United States-China agreements on prison labor imports and intellectual property rights; evaluate United States enforcement policies; and recommend what new measures the United States Government might take to strengthen our laws and enforcement activities and to encourage compliance by the Chinese.

WORLD TRADE ORGANIZATION COMPLIANCE.—The Commission shall review China's record of compliance to date with its accession agreement to the WTO, and explore what incentives and policy initiatives should be pursued to promote further compliance by China.

MEDIA CONTROL.—The Commission shall evaluate Chinese government efforts to influence and control perceptions of the United States and its policies through the internet, the Chinese print and electronic media, and Chinese internal propaganda.

FACT SHEET

U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

ESTABLISHMENT:

The Commission was created in October 2000 by the Floyd D. Spence National Defense Authorization Act for 2001 δ 1238, Pub. L. No. 106-398, 114 STAT. 1654A–334 (2000) (codified at 22 U.S.C. δ 7002 (2001)), as amended, and the "Consolidated Appropriations Resolution of 2003," Pub. L. No. 108–7, dated February 20, 2003.

PURPOSE:

To monitor, investigate, and submit to congress an annual report on the national security implications of the bilateral trade and economic relationship between the United States and the People's Republic of China, and to provide recommendations, where appropriate, to Congress for legislative and administrative action.

Public Law 108–7 directs the Commission to focus its work and study on the following nine areas: proliferation practices, economic reforms and U.S. economic transfers, energy, U.S. capital markets, corporate reporting, regional economic and security impacts, U.S.-China bilateral programs, WTO compliance, and media control by the Chinese government.

COMPOSITION:

The Commission is composed of 12 members, three of whom are selected by each of the Majority and Minority Leaders of the Senate, and the Speaker and the Minority Leader of the House. The Commissioners serve two-year terms.

COMMISSIONERS:

Hon. C. Richard D'Amato, Chairman; Roger W. Robinson, Vice Chairman; Carolyn Bartholomew, George Becker, Stephen Bryen, Thomas Donnelly, June Teufel Dreyer, Hon. Patrick A. Mulloy, Hon. William A. Reinsch, Hon. Fred D. Thompson, Michael R. Wessel, and Larry M. Wortzel (brief bios are attached).

STAFF:

The Commissioners are supported by a professional substantive and administrative staff with extensive backgrounds in trade, economics, weapons proliferation, foreign policy, and U.S.-PRC relations. Some are fluent or proficient in Chinese (Mandarin), and most have significant prior working and traveling experience in China and Taiwan. The staff is headed by T. Scott Bunton, Commission Executive Director (brief bio is attached).

WEB SITE:

The Commission's web site provides the Commission's complete charter, hearing schedule, hearing transcripts, and selected research papers, and economic and trade data www.uscc.gov.

The Hon. C. Richard D'Amato (Chairman)

Maryland attorney; former delegate Maryland House of Delegates; former Counsel to Senator Robert C. Byrd (WV). Reappointed by Senate Democratic Leader Tom Daschle for a term expiring December 31, 2005. Served as Commission Chair and Vice-Chairman beginning in April 2001 and was unanimously approved as Chairman for report cycle 2004 to 2005.

Roger W. Robinson, Jr. (Vice Chairman)

President and CEO, Conflict Securities Advisory Group, Inc.; former Senior Director of International Economic Affairs at the National Security Council. Reappointed by Senate Majority Leader Bill Frist for a term expiring December 31, 2005. Served as the Commission Chair beginning October 2002 through July 2004 and was unanimously approved as Vice-Chairman for report cycle 2004–2005 on July 19, 2004.

Carolyn Bartholomew

Former Chief of Staff, Counsel, Legislative Director, and Foreign Policy Advisor to U.S. House of Representatives Democratic Leader Nancy Pelosi; former Professional Staff Member on the House Permanent Select Committee on Intelligence. Reappointed by House Democratic Leader Nancy Pelosi for a term expiring December 31, 2005

George Becker

Vice President, Executive Council, AFL–CIO; former International President, United Steelworkers of America. Reappointed by House Democratic Leader Nancy Pelosi for a term expiring December 31, 2005

Stephen D. Bryen

President of Finmeccanica, Inc.; former Deputy Under Secretary of Defense and founder and First Director of the Defense Technology Security Administration. Reappointed by House Speaker J. Dennis Hastert for a term expiring December 31, 2005.

Thomas Donnelly

Resident fellow in defense and security policy studies at the American Enterprise Institute; former policy group director of the House Armed Services Committee; former editor of Army Times and executive editor of the National Interest. Appointed by Senate Majority Leader Bill Frist for a two-year term expiring December 31, 2006.

June Teufel Dreyer

Professor of Political Science at the University of Miami; Senior Fellow of the Foreign Policy Research Institute. Reappointed by House Speaker J. Dennis Hastert for a term expiring on December 31, 2005.

The Hon. Patrick A. Mulloy

Adjunct Professor of International Trade Law at Catholic University and George Mason University law schools; former Assistant Secretary of Commerce for Market Access and Compliance; former General Counsel, U.S. Senate Banking Committee. Reappointed for a third two-year term upon the recommendation of the Senate Democratic Leader beginning January 1, 2005 and expiring December 31, 2006.

The Hon. William A. Reinsch

President, National Foreign Trade Council; former Undersecretary of Commerce for Export Administration; former legislative assistant to Senator John Heinz (PA) and Senator John D. Rockefeller, IV (WV). Reappointed by Senate Democratic Leader Tom Daschle for a term expiring December 31, 2005.

The Hon. Fred D. Thompson

Attorney and former United States Senator from Tennessee and member of the Senate Select Committee on Intelligence. Former Special Counsel to both the Senate Select Committee on Intelligence and Senate Committee on Foreign Relations. Appointed by Senate Majority Leader Bill Frist for a two-year term expiring December 31, 2006.

Michael R. Wessel

Senior Vice President, Downey McGrath Group; former Counsel to Congressman Richard A. Gephardt (MO). Reappointed by House Democratic Leader Nancy Pelosi for a term expiring December 31, 2006.

Larry M. Wortzel

Visiting Fellow at The Heritage Foundation; former Director of the Strategic Studies Institute of the U.S. Army War College; former Army Attache at the U.S. Embassy in China. Reappointed by House Speaker J. Dennis Hastert for a term expiring December 31, 2006.

T. Scott Bunton—Executive Director

Served from 1998 to 2002 as Deputy Under Secretary of Commerce for Export Administration and in 2002–2003 worked in the Transition Planning Office in the Executive Office of the President that was responsible for "standing up" the Department of Homeland Security when it was established by law. Previously served as national security advisor, policy director, and chief of staff to two U.S. Senators, staff director of a Senate leadership Committee, and staff designee to the Senate Committee on Intelligence.

LIST OF WITNESSES, COMMUNICATIONS, AND PREPARED STATEMENTS