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U.S. SHIPYARD MODERNIZATION INITIATIVES AND SHIP COST REDUCTION

HEARING

BEFORE THE

SEAPOWER AND EXPEDITIONARY FORCES SUBCOMMITTEE

OF THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

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U.S. SHIPYARD MODERNIZATION INITIATIVES AND SHIP COST REDUCTION

HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
SEAPOWER AND EXPEDITIONARY FORCES SUBCOMMITTEE,
Washington, DC, Tuesday, March 20, 2007.

The subcommittee met, pursuant to call, at 2:48 p.m., in room 2212, Rayburn House Office Building, Hon. Gene Taylor (chairman of the subcommittee) presiding.

OPENING STATEMENT OF HON. GENE TAYLOR, A REPRESENTATIVE FROM MISSISSIPPI, CHAIRMAN, SEAPOWER AND EXPEDITIONARY FORCES SUBCOMMITTEE

Mr. TAYLOR. The committee will come to order.

Today's hearing will focus on shipyard modernization.

In the previous few years, under the leadership of Chairman Roscoe Bartlett, the committee has traveled to shipyards in Europe and in Asia. And in almost every instance, I think it is fair to say, the committee members were somewhat taken aback at the modernization of some of our economic competitors, as opposed to the yards that are producing ships for the United States Navy.

This is in no way to question the individual skills of the folks working at those shipyards, their dedication to build good ships. But I do think it is fair to say when you compare a Hyundai to a domestic yard or a Maersk to a domestic yard, we saw a great deal of capital investment that we aren't seeing in our own nation.

When we have had the opportunity to raise this question with shipyard executives, they point to their dilemma, in that they are responsible to their shareholders, that they basically have one customer, that, to a certain extent, they have a captive audience, and that it is hard for them to justify additional expenditures when they don't know from year to year how many ships they are going to be building.

I think that is a fair observation on their part. And so, the purpose of today's meeting is to see what we as a nation can do as far as investments on the part of our nation to stimulate shipbuilding, to stimulate shipyard modernization, and to see that this industry is here for decades to come.

I am pleased that the committee is moving along the path of adding several additional ships to this year's budget. But in fairness to the taxpayers who are going to pay for them, we want to make sure that the citizens get the best possible value while the sailors get the best possible ship.

We are very fortunate today to have Ms. Allison Stiller, Deputy Assistant Secretary of the Navy for Ship Programs; Vice Admiral

Paul Sullivan; Rear Admiral David Architzel; Rear Admiral William Hilarides; and Rear Admiral Charles Goddard joining us today. We are very, very grateful for your time.

We are going to have a second panel of distinguished representatives of the private sector.

But before we do that, I would like to yield to my ranking member and former chairman of this committee and a guy I have learned a heck of a lot from, Mr. Roscoe Bartlett from Maryland.

STATEMENT OF HON. ROSCOE G. BARTLETT, A REPRESENTATIVE FROM MARYLAND, RANKING MEMBER, SEAPOWER AND EXPEDITIONARY FORCES SUBCOMMITTEE

Mr. BARTLETT. Thank you very much.

Good afternoon, ladies and gentlemen. It is a pleasure to be here with you today to learn more about the Navy and industry's effort to control costs for naval vessel construction.

There are several key elements necessary to achieve cost reductions, including commonality of designs at the component and system levels, stability in the shipbuilding program, sufficient volume to optimize workloads, and shipyard facility modernization.

The chairman and I have traveled around the world to visit Europe and Asia's most competitive and efficient yards. We have seen the art of the possible and are eager to understand what role Congress might play to facilitate the transfer of best practices from these yards to the U.S. yards.

I was struck not only by what I saw on these production lines, which was the sight of relatively few handwelding, but also what I heard, or didn't hear, which was the relative quiet of advanced cutting processes such as lasers and water jets, and not the sound of a grinder in all of Hyundai, by the way.

The contrast to our naval shipyards was stark. I do not believe we are taking full advantage of these technologies and practices in the construction of U.S. warships.

How critical is the length between shipyard efficiencies and costs? I think we need to look no further than our recent experience with the Littoral Combat Ship (LCS).

While the issues with LCS are not directly tied to shipyard modernization, we have clearly seen that, once the modules for LCS–1 began to be constructed out of sequence and the ship was in the water without the maximum amount of outfitting having been completed, the resultant labor inefficiencies significantly increased the price of the ship.

With that said, I must also acknowledge that commercial yards have a very different task. Their key competency is construction of cargo and passenger ships, which are often simpler in design and require less oversight and integration of hull, mechanical and electrical systems.

These yards also benefit from economies of scale derived from large commercial orders. Instead, our yards must strive to create value for the Navy and their stockholders through a balance of strategies, such as industrial efficiency, network services and knowledge application.

As we have seen in foreign yards, industrial efficiency creates value by producing standardized offerings at low costs. But the Navy is never likely to need standardized, commoditized ships.

Consequently, we must also explore means to position our shipyards to connect people and services and to apply customized expertise to ship construction. If we were successful, we might even find that other nations and other customers would be interested in coming to the United States' yards for their most challenging, high-performance ship needs.

I hope that we will learn more about these various possibilities in today's hearing.

I would like to conclude by thanking our witnesses for their service to our nation and for being here with us today. I truly look forward to your testimony.

And sadly, I have an appointment to which I must go in a couple of minutes. It has been on the calendar for more than a month, and it is one that I just couldn't delay. But I will be back as soon as I can for the continuance of your testimony and the questions.

Thank you very much, Mr. Chairman.

Mr. TAYLOR. Thank you, Mr. Bartlett.

Do any other members have an opening statement?

Ms. Bordallo.

Mr. Courtney, do you have an opening statement?

Okay. With that, the chair recognizes Ms. Allison Stiller.

Ms. STILLER. I am actually going to have—Admiral Sullivan is going to give our opening remarks.

Mr. TAYLOR. Thank you.

Admiral Sullivan.

STATEMENT OF VICE ADM. PAUL E. SULLIVAN, COMMANDER, NAVAL SEA SYSTEMS COMMAND, U.S. NAVY; MS. ALLISON F. STILLER, DEPUTY ASSISTANT SECRETARY OF THE NAVY (SHIP PROGRAMS); REAR ADM. CHARLES H. GODDARD, PROGRAM EXECUTIVE OFFICER FOR SHIPS, U.S. NAVY; REAR ADM. DAVID ARCHITZEL, PROGRAM EXECUTIVE OFFICER FOR AIRCRAFT CARRIERS, U.S. NAVY; REAR ADM. WILLIAM H. HILARIDES, PROGRAM EXECUTIVE OFFICER FOR SUBMARINES, U.S. NAVY

STATEMENT OF VICE ADM. PAUL SULLIVAN

Admiral SULLIVAN. Good afternoon, Mr. Chairman, members of the subcommittee. Thanks for inviting us here to discuss shipyard maintenance and cost-reduction measures for our warships and how we can modernize our shipyards today.

As you know, I am the commander of the Naval Sea Systems Command, and my organization is a part of the team that is responsible for buying, building, maintaining and modernizing the ships of the Navy.

As already stated, the rest of the acquisition team members are here today, the three Program Executive Offices (PEOs) that build ships and Ms. Stiller.

Again, thanks for inviting us. And we would like to get, quickly, to the questions, so my statement will be short.

Without objection, we would like to submit our written testimony for the record.

Mr. TAYLOR. So ordered.

Admiral SULLIVAN. Sir.

As you know, the Navy has submitted the fiscal year 2008 long-range plan for construction of naval vessels to build us a 313-ship Navy. And that program is built on stable mission requirements, stable shipbuilding program, and stable costs of our ships.

And in order to succeed, that program is dependent on the costs of our ships being predictable and executable.

We are currently embarked on several fronts to decrease the costs of our new construction warships by working with our industry partners to modernize the ship-production process.

I will briefly summarize these initiatives, and then we will be happy to take whatever questions you have for specifics.

The first is the shipbuilding plan itself. You will not see major annual revisions to that shipbuilding plan because both pricing structure and production capacity and sequencing depend on the stability of that shipbuilding plan.

But in order to facilitate that, there are things that we can do. There are some near-term things that we can do, some mid-term things that we can do, I will say out five to ten years from now, and some long-term things that both the Navy and the industry partner teams should be working on.

Near term, I think that the Navy should be promoting block buy, multiyear procurement, teaming, open architecture and commonality. And I will speak a little bit about each one of those.

We need to assign the proper level of experience from our side in the Navy and sufficient numbers of people to properly steward these shipbuilding programs.

We need to encourage facility and process improvements at our contractor partners through incentives in our contracting structure.

We need to maintain a level workload through program stability.

And we need to act corporately as a navy and think cross-program, cross-shipbuilder wherever we possibly can.

In contrast, or I guess in concert really, our shipbuilding partners should benchmark off the best of the business and adopt efficiency strategies based on that benchmarking.

They should reduce the number of components and types of components, and that is really a team effort. We should buy common parts, such as valves, piping, cabling and electrical components.

I would ask our industry partners to reinvest profits into things in their shipyards that will increase their productivity.

We should investigate bulk commodity purchases where we can, like steel or pipe.

Share best practices across shipyards. We only have two corporations now, so best practices can be shared amongst the big six.

Act corporately to share resources and leverage materials buys.

Where Congress can help as part of the team is to support the stability in our shipbuilding plan as we submit it to you, support the multiyear procurement in the instances where we request it, and allow some flexibility to contract for parts in cross-class and maybe even some cross-contracting parts, pooling it so we could pool our purchasing power.

In the mid-term, again, 5 to 10 years out, I think the Navy should further increase use of open architecture past even just the combat systems; reduce our combat system baselines and surface ships from the current 16 down to 5 or 6.

We need to introduce commonality in our design tools. We should work, as we specify how our ships are built, to adopt class-common equipment if it is at all possible.

We need to promote amongst our industry partners an integrated product development environment where there is some common ground for interchange of information. Right now we have several different systems for all of that.

Long term, and I am talking past 10 years out, we need to, as a navy, try to reduce the numbers of classes of ships. Today we have 29 classes or subclasses of ships out there. Every one of those has a logistics and operational tail that is associated with it.

We should try to reduce our tight model series, like the aircraft piece of the Navy. And in that way, we can build more ships of fewer classes and have some standardization of processes.

We need to increase modularity on a much, much grander scale than we have today. We have modular construction today. We need to expand what we have in LCS to have mission modules across all our combatant ships.

We need to dramatically reduce, in the far term, the numbers and types of components that we have in our ships.

Strive for full data product model interoperability.

Again, some of these are repeats of what I just said, but in the long term we need to be continually working on that.

And open architecture on not just the combat systems and electronics, but also open architecture in a physical sense, that the ships can be reconfigured easily.

As far as modernization incentives for shipyards: common parts catalogue. That is a start toward an industry-wide ability to purchase out of the same parts catalogue. That needs to be expanded.

The integrated data environment improvements that are on the horizon today with the new design tools should be spread across our shipyards.

There are other incentives, such as Hurricane Katrina, which Ms. Stiller is prepared to talk about, if you want. That is an opportunity to work toward, at least for the Gulf Coast yards, to work toward recapitalizing them.

Other facilities incentives such as capital expenditures (CAPEX) and ultra hull facility, and the PEOs can talk to any one of those.

And I think we still need to continue benchmarking, every so often, our shipyards against the best in the world, with organizations like First Marine International, so we see where we are and then go try to close the gaps.

Both the Navy and the shipbuilders need a comprehensive, thoughtful program that works across the industry and across all of our class. We need to work better together.

Again, thank you for the opportunity to present to you. And we will stand by to take your questions from here on out.

[The joint prepared statement of Admiral Sullivan, Ms. Stiller, Admiral Goddard, Admiral Architzel and Admiral Hilarides can be found in the Appendix on page 41.]

Mr. TAYLOR. Thank you, Admiral Sullivan.

Do any other of our witnesses have an opening statement?

Admiral SULLIVAN. No, sir. I think the interchange is better.

Mr. TAYLOR. Admiral, I very much appreciate your statement.

The only thing that I didn't hear you mention that I have curiosity about would be government-furnished equipment.

And I realize, between the LCS and the Coast Guard programs, a lot of the changes that I think were proposed by Secretary Rumsfeld are now—in particular, design-build—I think those expertises are once again returning I think to the proper place, which is with the United States Navy and with the United States Coast Guard, to design the ship and monitor its construction. And understanding the needs of the yards to have some sort of predictability and an ability to tell their shareholders that their investment has been wisely spent.

What I didn't hear you mention was government-furnished equipment and to what extent the experts from the Navy, to what extent the experts from the Coast Guard when the case exists, do you walk through a yard and say, "You know, if you had this machine," be it a laser cutter or a laser welder, a CAD, any number of things that we saw at Maersk, any number of things we saw at Hyundai that we don't necessarily see at a domestic yard, does the Navy ever propose to the private sector the furnishing of equipment that would still be owned by the government as a means to control cost, knowing that the private sector, because of the limited number of ships that are being built, doesn't have a very big incentive to go get that themselves?

I am told it is the case for submarines. But I was just curious, have you ever made a proposal like that or has Ms. Stiller ever made a proposal like that when it comes to surface combatants?

Admiral SULLIVAN. I will let Ms. Stiller answer that one.

Ms. STILLER. Yes, sir. And on the government-furnished equipment side, there can be some confusion. We tend to think of that as our combat systems that we provide.

But for government-furnished tooling, what you are talking about, that typically becomes specified for individual programs or classes of ships.

For example, CAPEX has been used extensively in the submarine community. And I am going to have Admiral Hilarides give you a little more detail on that.

We have also embarked with Bath Iron Works recently on the ultra hull improvements that I am going to have Admiral Goddard allude to, that is toward the end of the DDG–51 class that could have benefits on future classes.

So usually the industry will propose to us things that they see specific to individual programs that will help efficiencies and productivity. And we have looked at different ways to incentivize that and be able to accommodate that.

And I would turn it over to Admiral Hilarides and then Admiral Goddard real quick to give you those two examples.

Admiral HILARIDES. Thanks, Allison.

The CAPEX program came about as part of the contract negotiations for the multiyear procurement of the Hull 6 through 10 of the *Virginia* class. And in the negotiations, I think it is important to

point out that it occurred in negotiation for a contract between the government and the contractor.

A piece of the incentive pool was set aside to help facilitize the shipbuilder to improve his cost performance. That incentive pool was set out there. It is $91 million.

And the shipbuilders, both of them, Electric Boat and Northrop Grumman Newport News, could come forward and propose a project that either improved the processes or the facilities at their yard that could show an immediate payback to the program.

And when that business case was accepted and signed up to by both the contractor and the government, the government paid for half of the cost of the facilitization. The contractor paid for the other half.

When the project was complete, the second half of the incentive pool for that project was released. So, in fact, government had fully paid for it with the caveat that the proof was in the production.

So the proof was in the next ship to be built. It showed either the savings that were promised by the project or it didn't. If those savings were proven, then the government let the contractor keep the incentive pool that had been put forward to pay for it.

If the savings did not appear—and we had very specific metrics for how you measure it—if the savings did not appear, the contractor would have to pay back the incentive to the government and would, in fact, have to absorb the costs of the facilitization that occurred.

A couple points just to make about the program.

We had a relatively mature design when we put the CAPEX in place. That is, we knew what it took to build the ship. And we had a very good idea of what kind of facilities would make it less expensive to produce.

And so I would encourage, as we think about CAPEX projects, to wait until our designs are mature and then make it part of the contract negotiations, not just something that the government would give to the shipbuilders.

Mr. TAYLOR. Would you call that program a success, Admiral?

Admiral HILARIDES. Yes, sir. We have seen savings. In fact, we have seen savings well before we thought we were going to achieve them. Those savings have appeared on earlier ships than the ships we negotiated the CAPEX for. In fact, we have seen it on the first two or three ships.

Mr. TAYLOR. And at what point did you recoup the Nation's investment?

Admiral HILARIDES. The business cases that we accepted were to pay back over two or three ships. And in general we are seeing that payback and sometimes faster, yes, sir.

Mr. TAYLOR. With that in mind, it is my understanding that we will have built, when the program is terminated, something like 50 DDGs, *Aegis* class. At any time was a similar proposal made to those two suppliers? And if not, why not?

Admiral HILARIDES. Sir, I think I will let Admiral Goddard address the DDG program.

Admiral GODDARD. A little bit different approach, Mr. Chairman, on the ultra hull facility that BIW is moving out on with our assist-

ance. Again, as you said, a large program, in this case 62 hulls will eventually be built.

The idea here is to continue to improve the productivity improvements that BIW has been seeing, and also to set themselves up for the DDG–1000 contract that is coming up.

And they came forth with a proposal to invest in a facility that will allow them to move some more of the pre-outfitting work earlier into the construction process and have larger units prior to erection than they do.

So we will see some savings on the tail end of the DDGs. And what we worked with them is an incentive for them, if they meet their targets, that they will be paid—it is roughly around $3.5 million that we have set up in the contract.

But what they have done for us is they have lowered the ceiling prices on the contracts, and they have also lowered targets. And if they underrun the targets, we have agreed to give more of the money back to them on the share line. So it has been a good position for both of us.

Part of the thing that the government did is we agreed to early release of retentions on payments, in order for them to free up some cash to go make that investment.

Now, we won't see those returns for a while. The facility doesn't come in until 2008. But a downstream improvement to the DDG–1000 is they also lowered their price to us, which we are in the midst of negotiating, to account for those efficiencies that they are going to see.

So, for a modest investment on the government's part, in terms of incentives and in terms of early release of retentions, we are going to get some significant benefits downstream on that program.

Mr. TAYLOR. Admiral, help me with this. On a cost-plus contract, what incentive does the private sector have to come to you and say, "I want to save you some money"?

Now, I will use the analogy of I am building a house right now. I have got a contractor who gets 20 percent on the top of everything that I spend. He really doesn't have much of an incentive to save me money. It is the only house I am ever going to buy.

On the flip side, we are those six shipyards' only customer. And so I am having a little trouble with understanding why they would be incentivized to find these savings, as opposed to someone from your office making that proposal to them.

Admiral GODDARD. I understand, Mr. Chairman.

In this case, because of the surface combatants, we are fortunate that we have two yards to build those surface combatants. And so, what this does is this helps to set them up to perhaps get better terms downstream when we go to run the competition for those follow-on DDG–1000s.

We have several ideas on how to do that, either a profit-related kind of offer that we did on the DDGs, which was very successful in keeping the costs down between the two yards on those. Or perhaps, in the case of quantity, where we have an odd number of ships, the lower-priced yard would get an additional ship to go build.

So those are some of the things, downstream, that help incentivize these kinds of investments for us.

So it is important to maintain competition between yards where we can, like we have enough numbers with the combatants.

Mr. TAYLOR. To what extent can you point to, in the aftermath of Katrina, when our nation very generously offered to help some of the yards that were damaged by that storm, to what extent can you point to the Navy walking through those yards and saying, "You know what, for the future you need to be doing this. We are willing to help you with an investment for this"—fill in the blank.

Can you give me any examples of that?

Admiral GODDARD. Mr. Chairman, I am relatively new to the Program Executive Office (PEO). Allison Stiller was involved in all of those. I am going to pass the question, if you don't mind, to her, who did a lot of the selection of those projects.

Ms. STILLER. Yes, sir. One thing that we are mindful of, in the Navy, is that the shipyards understand their processes and the production flow in their particular yards better than the Navy. We can pass along ideas that we have seen in other yards, but they have to apply it to their own yards and their own processes.

What Northrop Grumman Ship Systems, that I am sure Mr. Teel can comment on—he is in the next panel—did right after Katrina was bring in First Marine International, who had done the benchmarking study for the Office of the Secretary of Defense (OSD), and hired them to come in and help them in their yard to understand what flow, what projects should they be investing in for the future based on their yard and the projected workload in the future.

Some of those suggestions manifested themselves in proposals that came to the Navy for the Katrina $140 million that was specifically carved out, that the Navy ran a competition with the affected Gulf Coast yards for.

Northrop Grumman was selected for three projects under that. And one is the panel down at Ingalls, as well as at Avondale, and another one was in their Gulfport facility.

We are in the process of negotiating the final terms of the contracts. But we feel very confident that that is going to have return on investment for the Navy and for the company.

There was state investment, as well as corporate investment, in those projects as well. They were able to demonstrate to us that we will see return on investment.

And, in fact, the panel line accomplishment at Ingalls, we will want to see the returns there, just to verify the return on investment before we enter in to the next one at Avondale.

Mr. TAYLOR. The chair yields to the gentlewoman from Guam.

Ms. BORDALLO. Thank you, Mr. Chairman.

I have just a couple of questions.

I think, Admiral Sullivan, you probably would be the one to answer this, or any of the other witnesses: What specific types of things can be done to modernize our shipyards? Would these things result, then, in lower- or higher-priced warships?

And why do the shipyards currently not make these investments from earnings? What prevents the shipyards from attempting to match the world-market standards in automation?

Admiral SULLIVAN. Ma'am, why they don't make the investment—well, first, they are making some of the investments. And you have heard a couple of——

Ms. BORDALLO. Yes, I did.

Admiral SULLIVAN. I will turn it over to Admiral Architzel to hear what is getting done with the aircraft carriers.

But I have to say, and you can ask the next panel, but for each shipbuilder, they work for a corporation that has shareholders, and those shareholders need to see a return on investment from the corporate position.

And they each have the hurdle rate. And if an investment in the facility can't make the corporation's hurdle rate, they have a tough time selling it.

And I have been involved in some of those discussions, where, at some times, the Navy has been able to supplement or through a contract incentive make the difference. Or in some cases, the states have kicked in and helped out with capital expenditures.

But there is a lot we can do on the contract, with contract incentives, and I would like Admiral Architzel to comment on that.

Admiral ARCHITZEL. Ma'am, Admiral Dave Architzel, PEO, carriers.

On the carrier aspect of it, we are in a construction preparation contract, and we have been in that since 2004 on the CVN–21 program.

I would like to approach this from three areas, if I could, also, to the chairman's question. It comes down to incentivizing or how do we incentivize and assist? And there are three areas: cost, performance and schedule.

If I took the first piece, I would say we have a construction preparation contract that deals with fixed-fee-type awards. Those are, right off the bat, for things like long-lead propulsion plant design or long-lead material buys, advance construction.

For example, in 2006 and in 2007, we will look at commenced advance construction at—at contract award in 2007, we will have fully 25 percent of the hull units for the lead ship will be in some phase of some construction.

And this is where you have gone seven years from the start of the last carrier to the start of this carrier. So this is really assisting stability and bridging that area for the shipyard to bring the workload, to help them with some of that as well.

But it is also learning how to build some significant aspects that are different on the 21 program—the lead ship, 78, as opposed to the *Nimitz* class.

So on the second piece, the second area, award fee, is also included in the construction preparation contract. That goes to encouraging platform design progress, design model products.

Initially, we started off with awarding the award fee that focused on attaining the key performance parameters needed with the ship. Those refer to things like manpower reductions, sortie-generation rate, electrical power generation, the weight and KG critical performance parameters that are desired to be key performance. So we had award fee for that to encourage the attainment of those threshold values.

And then, as we went forward, we realized that we also had special incentives we wanted to encourage the shipyard, and those dealt with two areas primarily.

The first dealt with our facilities and meeting future facilities. We can't buy facilities for the company, but we could incentivize to schedule. By that I mean, we looked and talked with a company about what facilities did they need that were unique for the CVN–21 program that they needed to build in their yard.

They covered a wide range of areas. They came forward with a covered maintenance assembly facility, which is a huge facility under roof, first time they have had that kind of capability.

Today, if you were to go to that shipyard, you would see propulsion plant units from both the carrier and the *Virginia* class submarine program in that facility being constructed.

In addition to that, we had a need for a heavy steel plate facility. This carrier has four-inch plate steel that would be plates of steel from me to you, that length, four-inch thick, hundreds of tons in weight.

If you were to take in the old design measures or handling measures to turn those steel plates, it could take up to a week sometimes or days to turn a steel plate. The machines that we bought, in place now, can turn that machine in hours. And you can also level the plate. You can also torch the plate and cut it to size much more efficiently.

Then you have the covered maintenance assembly facility, which goes to the point I heard before from my other PEO colleagues that talked about moving to the berthing dock, the Dry Dock 12. We actually have a covered maintenance assembly facility there where we can outfit in much higher detail than we have previously done, which will reduce the cost on assembly of the ship, as you can have higher production units put into the actual berthing dock, Dry Dock 12, when you actually build the ship.

Also envisioned in this incentive is the power unit assembly facility, which will be where we will build the actual propulsion plants themselves, which will be also built adjacent to the dry dock so that we can have a crane that can lift it directly into the Dry Dock 12.

To do this, we now have heavier assemblies, recognizing that these are not going to be able to be handled by the 900-ton gantry cranes presently at Northrop Grumman Newport News. So we also looked at: What cranes will you need, and what size will you need? Will they need to upgrade that crane to a 1,050-ton crane? That is also part of our incentives.

We incentivize these schedules because they all want to—making schedule sooner for our lead ship as we need it. The amount that we actually put in incentive was $30 million. The company invested around—today that would be somewhere around $180 million of capital funds.

I believe, if we looked at our global sheets projected now as we go toward our cost datasheets for the actual contract awarded to the ship, you will see that the return on our money has already come back. More than our $30 million investment has already come back. Today, I would sit at around $58 million just on the lead ship alone.

So these do make sense, these kind of incentivized areas.

And the second type of incentive would be for—I mentioned we had gone after our key performance parameters. And we found, over a very short period of time, that we actually were meeting thresholds in all our key performance priorities. But where we really now had to get to was our cost target for the ship.

So we changed in this year, 2007, in our construction preparation contract, we changed our incentive to be—instead, took some of the award fee away from making KPPs, which we were already making and we are satisfied with that, and we took that money and applied it to an incentive to cost target.

So we now take and challenge the company to come down from where they presently are estimating our contract costs would be of delivery of both recurring and non-recurring, and on both sides, both on the recurring, which would be the design for the whole class of ship, as well as the construction end for the lead ship itself, and task them to come up and make progress toward those targets.

And, when they do, they are incentivized by getting incentive feedback for that effort. And if they were not to make those incentives, then they would lose that incentive.

And it seems to be working rather well. And we are optimistic as we head toward the December 7th contract award.

Thank you.

Ms. BORDALLO. All right, the other question is: We have heard that foreign commercial yards are much more efficient than the U.S. yards. At least that is what we sort of saw when we toured the shipyards in Asia.

Are foreign military vessels constructed at these commercial yards?

Ms. STILLER. Yes, ma'am. In some cases—it depends. In some of the yards we visited, they did build military ships as well as commercial ships. In some cases, those yards had that military construction segregated off from their commercial construction.

What we found in the Yokohama yard, IHI, was that their surface combatant, price-wise, as they translated it to U.S. dollars, was probably comparable to a DDG–51, in a follow-ship kind of configuration, although their surface combatant is smaller, but if you scale it, it was about the same. And we saw that at Hyundai as well.

And they were building on about the same build cycles as we see on our DDG–51 program. A little bit smaller vessel, but price-wise, they are about the same.

And as I recall, most of their discussion on their military side was they don't build them in the quantity, both in how many you buy a year—a lot of times, theirs was spread out much like we spread out our Navy buying.

Ms. BORDALLO. I do remember touring one of the shipyards where they did say they worked on military—but I couldn't remember which one it was. Was that the one in Hyundai?

Ms. STILLER. Both of them.

Admiral SULLIVAN. It was both IHI and Hyundai.

Ms. BORDALLO. Right, right.

Okay, now, getting back to the comments you made, Admiral, I just can't figure out why we couldn't build into the contracts, when

we do build commercial ships of any kind, not just the carriers—well, you spoke of the carrier, right? Wasn't that what you were discussing?

But when we build the commercial ships, why can't we build something into the contract when they contract with us, to set aside for modernization of the plants. Could that be a possibility?

Ms. STILLER. Well, in the case of—if a shipyard gets commercial work in the yard, where they are building Navy ships as well, we certainly see an advantage—you know, an overhead reduction and even on the vendor base, in some cases, if they can leverage buys.

We don't have a mechanism to incentivize them, necessarily, for commercial work. We can incentivize them to improve productivity on their Navy work, which could indirectly transfer to their commercial work.

Ms. BORDALLO. Do we ever lose money?

Ms. STILLER. Do we ever lose money on our ship contracts?

Ms. BORDALLO. Any of the commercial ships?

Admiral SULLIVAN. Are you asking, do our shipbuilders lose money when they build commercial——

Ms. BORDALLO. Yes, or just break out even, or——

Admiral SULLIVAN. They have been all over the map. Some have had dramatic losses, and some have had break-even. Most of the Jones Act ships are okay.

Ms. BORDALLO. Thank you, Mr. Chairman.

Mr. TAYLOR. I thank the gentlelady.

Now the gentleman from Connecticut, Mr. Courtney.

Mr. COURTNEY. Thank you, Mr. Chairman.

And, Admiral Sullivan, just looking through your testimony, on page three where you, sort of, gave the recommendations about what Congress can do and the shipbuilders can do, I mean, there seems to be, sort of, a common thread there in the recommendations, about our job would be to promote stability in the shipbuilding program and that the shipbuilders should do their best to try and, again, keep some kind of even keel or level pattern, in terms of just trying to keep the momentum going forward.

But it just seems to me that, at some point, you know, we are kind of stretching the bubblegum to almost the breaking point, just in terms of the size of the work that is out there.

After Admiral Hilarides and others testified a couple weeks ago on the submarine-building program, we heard from the manufacturers afterwards. And Electric Boat and General Dynamics testified that they are pretty much at the tail end of running out of repair and maintenance work, which is really going to put them in a pretty bad place as far as maintaining stability in the workforce that is there.

And, you know, with the shipbuilding plan that the Navy is promoting right now, that they really are going to struggle in terms of whether or not the workforce is going to be able to hang in there until 2012 when it goes up under the Navy's proposed plan.

And it just seems that the goals of trying to get more efficiencies with volume purchases, which Ms. Stiller, you know, indicated in the case where you have commercial and Navy shipyards, I mean, obviously that is where you get those benefits.

I mean, is this budget enough to really keep these shipyards moving in the right direction? Or are they just going to limp along and not get the benefit of the economic order efficiencies and the volume discounts that they can get for materials and maintain their workforce?

Admiral SULLIVAN. Yes, sir. Tough question. The budget that you see coming in the President's Budget 2008 is more than it was in the President's Budget 2007. And that shipbuilding program, if we hang with it, will eventually produce us that 313-ship Navy.

The stability is important because the shipbuilders need to know that they are at least getting that next ship.

And I guess I am showing my age, because I am coming at this from the context of having been a submarine program manager during the 1990's when we did not order very many submarines at all and trying to get to a stability in the Virginia program where we were at least getting one per year.

So, it is stable. Is it at a rate that I would personally like? We would always like more ships. But in the context of running a 313-ship Navy and trying to build the classes and types of ships that we need to meet the warfighting needs and also balance the aviation procurement issues that we have along with the operation part of the Navy, that is what the budget will bear. And it supports that 313-ship plan.

Mr. COURTNEY. I mean, obviously, though, I mean, if we look in the recent past, I mean, there was an expectation at one point that we were going to be at two ships a year, two boats a year, and that kept getting sort of pushed back to 2012.

And, I mean, obviously, the proposal for this year's budget, you know, that is really sort of begging the question about whether or not that commitment is going to be there to get us to that next level of economic order efficiency, because that is really a future Congress that this budget sort of leaves that question to.

So I am just sort of looking to see where, you know, our support of the President's plan achieves the goal of supporting stability in the shipbuilding plan. Because the real tough choice is really further down the road, the way it has been presented, isn't it?

Admiral SULLIVAN. Yes, sir. Getting to two a year in 2012, that represents a significant investment.

I would like Allison to talk about what the Navy has done and will be doing to try to smooth that out.

Ms. STILLER. Going to two a year in 2012, we also submitted, as part of this year's budget, a legislative proposal to do multiyear procurement for the next block buy on *Virginia*-class submarines. And that includes submarines between fiscal year 2009 and fiscal year 2013.

In the legislative analysis for that, it is clear that we will have to go to two a year. And our plan is, in the shipbuilding plan, is to do that in 2012 with advanced procurement money in the budget in 2010 and 2011.

So we submitted the multiyear request this year, as opposed to waiting for next year with the budget, so that we show the commitment that we, the department, are serious about a multiyear procurement for this next block of submarines.

So I think, yes, the budget has to come to fruition later on. But right now the multiyear procurement legislation request is setting the stage for that.

Mr. COURTNEY. And so, that is how we can respond to Admiral Sullivan's suggestion in his testimony——

Ms. STILLER. Yes, sir.

Mr. COURTNEY [continuing]. That we promote stability?

Ms. STILLER. Yes, sir.

Admiral SULLIVAN. Yes, sir.

Mr. COURTNEY. I guess the other question I have is that, as far as trying to maintain the stability in the workforce, I mean, it really does seem up there right now that the repair and maintenance work, there is almost a cannibalistic sort of atmosphere of building up amongst the shipyards there. And I just wonder if you could comment on if there are ways of sort of using that as a bridge.

Admiral SULLIVAN. Yes, sir. And the fact of the matter is the submarine in particular, the submarine repair workload, is going down. We are at peak and starting to go down the other side of the peak of these submarine—the *Los Angeles*-class and the *Ohio*-class submarine refueling overhauls.

And when those are done, we won't be refueling those ships again. And that represents less work for the entire slate of shipyards, both public and private, that do repair work on submarines.

So what we have tried to do is come up with a comprehensive plan to balance the remaining submarine repair work across the public and private sector with a set of priorities: We would like to overhaul the submarine in home port wherever possible, and look at the workload of each particular shipyard and try to decrease the bumps or the peaks and valleys in the workload.

And that is an overall shipyard business plan that I would be happy to share with you at another session.

Mr. COURTNEY. Great. Thank you.

Thank you, Mr. Chairman.

Mr. TAYLOR. I thank the gentleman.

Ms. Stiller, I am curious: In 2007, what kind of recommendations, as far as government-furnished equipment, did you make? Specifically, you talked about the panel line at Avondale.

I guess I will preface that by saying, at least for the two Gulf Coast yards, I know that there is a reluctance on the part of management in two ways: Some of them fear that if the numbers of shipbuilders go down, that they will lack the political clout that it takes to fund these ships. I get this secondhand.

The one I have heard firsthand is the return on investment to their shareholders, and that they have to explain to corporate that this is not a highly profitable thing, that it is important to the future of the yard.

But, to the first point, with Hurricane Katrina and the shortage of labor in the region, the yards really did have an opportunity to modernize without laying off a single worker. To what extent did your office take advantage of that situation?

Ms. STILLER. Mr. Chairman, well, we looked at the proposals that came in under this Katrina 140, I call it—$140 million. We specifically asked to understand what efficiencies we would see in the yard as a result of the projects that were proposed, the return

on investment that we would see by these efficiencies and to our programs, and also the level of commitment, either corporately or state or locality.

So all of those proposals—we also wanted to understand, you know, how that would apply in the future as well as return on investment, immediate.

We got proposals well beyond $140 million. And so we had to make some hard choices in how we went about it.

But in some cases—and I would ask that you pose this to Mr. Teel, too, when he is up next—but Ship Systems, for example, have proposals that they intend to fund through their corporate measures, as well as through some of the proposals that we selected through this Katrina money.

There is a comprehensive plan that we have seen from Ship Systems that shows all the investment they intend to make within their yard post-Katrina and how that feeds into the ships that are laid into the Navy's budget so that they can effect the cost savings into those ships over time.

So there is a broader investment, not just from the Navy, in this Katrina 140, that the shipyards are also doing. And Mr. Teel can certainly elaborate on that.

Mr. TAYLOR. How much of your 2008 prospective budget do you plan on allocating for shipyard modernization funds?

Ms. STILLER. We have no funds that are set aside directly. But as Admiral Hilarides and Admiral Goddard talked about, there are program funds with existing contracts where—and Admiral Architzel as well—where the programs are incentivizing the yards in different ways. Because it is important for us to be able to see how we are going to see those improvements in a particular program so we understand the savings and that we can account for them.

So we tend to attack this problem program by program, although we do try to look and share across, for example, if there are multiple—for example, Newport News, where submarines and carriers are being constructed, the two PEOs share incentive ideas. And, as Admiral Architzel said, an investment that he made in the carrier program also has benefit to the submarine program.

So we try to make sure we see that, but we want to tie the program dollars into the return on investment so that we can see the savings and capture the savings as well.

Mr. TAYLOR. So you do not have a dollar amount in mind?

Ms. STILLER. I don't know, by program, what we have done. No, sir, I don't have that in mind.

Mr. TAYLOR. Would any of you other gentlemen?

Admiral ARCHITZEL. Mr. Chairman, I think there is, in addition to things like the CAPEX or incentives, as I mentioned when I talked about how we worked for schedule incentives to do that, there are also other areas where we have worked with a company, from my case, from Northrop Grumman Newport News—two concrete examples.

One would be the building of the new pier, Pier 2, at Northrop Grumman Newport News. That pier, we can't give dollars to do that, but we did work with the company that established the need for the pier, established the need for how we would go about doing

this, and worked with them to say how we could get them some business relief or waivers to accelerate a depreciation, that made the business case more attractive for them to build that pier.

That pier is built. It will be used for the 70 or the 77 as we go down and now use that pier. It is a double-decker pier. It keeps things out of the weather. It has much more efficiencies in line as we go forward at that yard.

In addition, with the 70, we needed some additional shore steaming equipment that was not there. And we used program dollars, where they are appropriate, to come in and assist on that facilitization, very specifically to shore steaming.

So two examples, also, that it has done, sir.

Mr. TAYLOR. Okay.

Admiral HILARIDES. Sir, if I could on that, I would say that there are tens of millions of dollars still available in the CAPEX program. That program hasn't played all the way out, and the shipbuilders are evaluating other ways to continue to use that incentive.

So there are additional resources. They were set aside as part of the total contract, but they are still available.

Mr. TAYLOR. Under your 2007 funds.

Admiral HILARIDES. Yes, sir.

Mr. TAYLOR. This year.

Admiral GODDARD. There are other vehicles also, Mr. Chairman, that we use, like National Shipbuilding Research Program (NSRP), where we work with the shipyards. And we collectively have contributed to that program with them, where they come forth with some proposals that will benefit all of us.

The common parts catalog that you heard about is one of those initiatives that was undertaken under NSRP. And we also have another one that is under way with common data exchange to get at this. If we don't have common tools, at least let's have common data that we can pass back and forth.

Mr. TAYLOR. Admiral Sullivan, you were talking about modularity for future ships. To what extent will the DDG–1000 be modular?

And I have to express my personal frustration when the Navy retires a ship at 17, 18, 19 years. And I would sure hate to see the DDG–1000 fall into that category because we weren't planning ahead.

Admiral SULLIVAN. Yes, sir. It is modular to a very large extent. I will let Admiral Goddard talk to that, because he has got the ship and he was also the program manager that designed the ship.

But to take that one step further, Mr. Chairman, and say, okay, we now have a stealthy, medium-sized surface combatant hull form, hull structure, electric and propulsion machinery physical plant that now, if at all possible, should be used as the infrastructure that supports future surface combatants beyond DDG–1000. That is where I would like to take the Navy in the far term.

Now, in terms of the specifics of how modular is the ship itself, I would like to turn that over to Admiral Goddard.

Mr. TAYLOR. Admiral.

Admiral GODDARD. It was one of the first ships that we had an open architecture requirement on. So the software has been developed with that in mind.

Additionally, how we put the electronics in are enclosures that were meant to be modular, so we can easily upgrade and refresh the blade servers, for example, on a total ship computing environment.

We took a look at the BLS cells, which are a modular form of deploying weapons, and looked at growth capability in those, in order to position ourselves for missile defense downstream and how much growth we might need to put into those cells to be able to go do that.

It has a very large aviation facility in order to stay pace and look at different options in terms of what we want to deploy from air vehicles from that platform.

So there is a lot of thought given to those kinds of things in terms of modularity, as well as the growth piece that Admiral Sullivan talked about in terms of positioning that ship to be modified to be a future cruiser, if that turns out to be the right path.

Mr. TAYLOR. What about electrical power generation? What sort of excess capacity will the ship have?

Admiral GODDARD. Sir, that ship has 80 megawatts of power. It uses that power only under very rare circumstances, essentially when it is going as fast as it needs to go, 30 knots-plus, plus is going to use all its weapons and so forth.

So the majority of its operational profile, it has a lot of excess electric capacity that can be used for growth. And that was part of the reason that we switched to the integrated power system on that ship, to position ourselves for some future weapons.

Mr. TAYLOR. And that translates to what in percentages?

Admiral GODDARD. When it is normally operating around, let's say, in a 5-, 10-knot type of loitering position, it is only using roughly 20, 25 percent of its power.

Mr. TAYLOR. Okay.

Admiral SULLIVAN. There is an equivalent example in the aircraft carrier world. Admiral Architzel can tell you about the upgradability of that ship for the future and how much excess power that has, if you would like.

Admiral ARCHITZEL. Mr. Chairman, on the 03 level, which is the gallery deck for the carrier, in the past, when you would come in and deploy a carrier your combat system resides on the 03 level.

And every time you would make a deployment, we would come in and change that whole combat suite out. And it involves welding, cutting—very disruptive overhauls to the ship every time you do that.

The CVN–21 program and the lead ship, the 78, are designed with a flexible infrastructure on the 03 level for about a hundred frames on the 03 level, about 400 feet.

That will allow you to then take in-deck mounting systems which will allow for adaptive installation of what is required for furniture, more cots adaptation. It also has ducting in the floor, so you don't have to come in and change ducting every time you modify space.

Electrical zonal distribution, which will bring electric power to the space and allow it for distribution within there.

So a much more adaptive architecture for the future, as we go forward, to allow that kind of change without having to go in and cut and weld every time you want to make those kind of changes to the ship.

You mentioned electrical distribution. This carrier will have 2.5 to 2.7 times the electrical capacity of the *Nimitz*-class. And it will also have zonal distribution. And the electrical distribution itself is distributed, such that we have much more power available on the 03 level than the Nimitz design, where you might have even had power but you couldn't distribute it to where you needed it.

Mr. TAYLOR. The chair recognizes the gentleman from Pennsylvania, Mr. Sestak.

Or would you prefer I go to the ranking member? Whichever is easier for you.

Mr. SESTAK. I am sorry. Say again, sir?

Mr. TAYLOR. Are you ready, or would you prefer if I went to the ranking member?

Mr. SESTAK. I will defer just for a moment. Thank you.

Mr. TAYLOR. The chair recognizes the ranking member.

Mr. BARTLETT. Thank you very much.

Mr. Chairman, we have talked in the past of a conflict that our shipyards have had that is not of their making and not of ours either but is just a reality today.

When I repeat the "Lord's Prayer" and I come to that part that says "Lead us not into temptation," I have some concern about some of the things that we do in the Congress, like putting young men and women together on ships, as an example.

But I want to chat for just a moment about a conflict that we have in shipbuilding. We have these shipyards that have, in effect, a captive audience, as you pointed out. We are their only customer. In reality, the only people that build ships for us is them, and the only people they build ships for is us. And so, we really are kind of captive to each other.

But they have a fiduciary responsibility to their stockholders, which means that since there is really hardly enough work to go around, it doesn't make a whole lot of sense, with your commitment to your stockholders, to invest a lot of money in upgrading the shipyards, because you are going to get the work anyhow.

That is just the reality of where we are. We have so few ships to build and so few people building them. And, looking to the future, we might get by now with less shipyards, but what if we had a surge? And with nobody there to build the ships, so from a national security perspective, we appropriately make the argument that, "Gee, we have got to keep all these shipyards alive."

And I have used the analogy before that we are very much like the farmer with seven horses and enough food to keep five really healthy. We keep moving the food around to the horse that looks the worst.

And how do we get by this?

And I know that people that run our shipyards want to do two things very well. They want to do the best thing they can for the country and the taxpayer, and they also have a responsibility to their stockholders. And these two things are in real conflict.

And absent real competition, which is where we want to get, is there another way around this? Or do we just have to get to real competition, no matter what, to get us out of this dilemma we are in?

Admiral SULLIVAN. Mr. Bartlett, volume of work always helps. Volume of work is what we can provide in the context of the 313-ship Navy. And that is where our budget is, or the Shipbuilding & Conversion (SCN) portion of the budget, is going up.

Commercial work would help, because it provides volume. It provides the flexibility to share overhead, and that helps some.

Mr. BARTLETT. But unless they become more efficient and do it cheaper, we are not going to get the commercial—it is kind of a chicken-and-egg thing. Where do you start?

Admiral SULLIVAN. Yes, sir.

Mr. BARTLETT. Clearly, clearly, if our yards were modernized to the extent of some of the foreign yards we saw, if they had the efficiency out there, they could be getting commercial work.

But if they are not going to get the commercial work, then the argument for making those investments just is extremely difficult when their only customer is us.

Admiral SULLIVAN. I agree, sir. It is very tough.

And when you were out of the room, we talked about some of the measures we had been taking. Some are contract incentives that the three PEOs talked about. In some cases, there are ways that, if an improvement does not meet the hurdle rate of the corporation, that the Navy and the state have come in.

And the instance I can think of is graving docks at Electric Boat, where the state helped and the Navy helped, and that got those two docks modernized.

And that is exactly what you are talking about, that surge capacity. Because for the workload that Electric Boat has in submarine construction, they don't need those two graving docks. But it is a good thing to have for the United States Navy, so we all came out winners on that one.

More of that needs to be done, but it is really on a case-by-case basis for each facility's improvement.

Mr. BARTLETT. Yes, I am convinced that everybody in the shipbuilding area and everybody in the Navy is doing the best they can under the circumstances. It is just that we are in a very difficult situation where we are where we are because of where we are. And if we are going to move off of that, something has to give. And that is why we made these visits to all of these shipyards around the country.

But I think everybody agrees where we are now is not fair to the stockholders, it is not fair to the workers, it is not fair to the taxpayers. And we just have to find a way around this, and I appreciate very much your commitment to try to do this.

Thank you, Mr. Chairman.

Mr. TAYLOR. Thank you, Mr. Bartlett.

The chair recognizes the gentleman from Pennsylvania, Admiral Sestak.

Mr. SESTAK. Thank you, Mr. Chairman. I apologize for coming in at the last minute.

Admiral, I have a question. There was a study done by the Deputy Under Secretary of Defense for Industry Policy a couple years ago, and I know it received a mixed review within the Navy.

My question is, though, that what I was most struck by in that study was how it talked about the need for collaborative initiatives between industry, the Navy, Congress, and other government departments. But there were words in it like "gain a more in-depth understanding, work with industry, review the acquisition rules with them, stabilize ship acquisition, improve incentives, continue to support them with improvements."

Has there been any thought given to—in my limited understanding of kind of watching it from here is, watching people come and go, there always seems to be these groups, but I have yet to really see a group that involves this type of a collaborative approach.

I am wondering if there is not something that can be done more in that line along the area of bringing—and this will also be your area, too, but if you didn't mind, Admiral, for yours, and then step over to her area.

We talk about this a lot and studies have talked on it and I probably dismissed it, but it just seems as though there are at least three or four principal partners here, of which Congress obviously is one and industry is and the Navy is, to bring it together in much more than a, "Yeah, we talk to one another," but a much more almost formal type of an approach to this, as this study talks about.

Admiral SULLIVAN. Yes, sir, excellent question. And I agree with you. There is a lot that can be done.

And I mentioned some of those things earlier in my testimony——

Mr. SESTAK. And I apologize.

Admiral SULLIVAN [continuing]. Where we should be thinking cross-class, buying by commodity, buying off the same parts list, trying to figure out a way within the law and within the ability that we can in the contracting world, sharing the load, if you will, across working with our shipbuilders on our various programs.

And in that light, Ms. Stiller started a series of meetings last year with the PEOs, and I have joined in in the last couple, to start working as a group to try to figure out what are the policy changes that are needed, how do we collaborate together and how do we work across contract. And I would like her to talk about that.

Mr. SESTAK. If I could, Admiral, though, Admiral Owens always used to say, "There are enough studies out there." And, you know, is it time to just formulate it?

And, yes, now we have got PEO talking with NAVSEA within the Navy, and I gather that is an accomplishment. Is it really important that we now get in the industry in that same room and Congress in that same room?

Because, I mean, two years ago, you could have heard the same question come up here from Mr. Taylor or the other ones.

Is it time we actually formalized that and moved out on that?

Admiral SULLIVAN. I would say we have got the first two. We have formalized and we are moving out on NAVSEA PEOs and industry with a thing called Joint Executive Management (JEM), and Allison will talk to that in a second.

Involving Congress as a formal entity, we have not done that yet, and that is something maybe we should explore.

Mr. SESTAK. But you have involved—but industry is——

Admiral SULLIVAN. Yes, sir. And if Allison could elaborate, that would, I think, help.

Ms. STILLER. Yes, sir. When I first came into the job, it was apparent to me, not just at the PEO level but at the program manager level, within the Navy, that because they are so focused on their program, that we didn't have a lot of opportunity to share ideas across multiple programs.

So I started, informally at first, meetings just so the program managers across the three PEOs would get to know each other and know what the other ones were working on.

As a result of that, we have come out with some specific actions that we have taken together on how we deal corporately, as a better corporation, in dealing with our industry partners.

One of the outgrowths that didn't start from this forum but that Admiral Architzel and Admiral Hilarides have instituted and we have been working in for a while is this Joint Executive Management Group, which is a partnership with Newport News, because there are cross-implications in submarines and carriers. So we have begun to expand that, in working with industry.

We also have continuous dialogue with our industry partners, probably more on an informal level than you have alluded to. But I think there is really good dialogue, especially with all of the industry partners.

We understand their needs on stability, and we have been working very hard within the department to stabilize the shipbuilding plan, to get at that requirement.

We have also encouraged industry corporately to look at corporate ways to leverage across their yards, in material buys or in workload sharing and that sort of thing. And we have seen some of that.

So I would agree with Admiral Sullivan. We have started in certain areas. Have we involved the Congress? No. Can we and should we? Absolutely.

Mr. SESTAK. I guess the reason I ask—and I don't really know the acquisition side that well, but I can remember—I mean, it is important, and, Admiral, you have to correct me, but I think the submarines had an HF sonar or something that ended up being used on the DD—what is it called now?

Ms. STILLER. DDG–1000.

Mr. SESTAK. DDG–1000. But initially that wasn't going to happen. I mean, it was because the Navy—and I gather you did—brought them together that all of a sudden we got a good buy on this, because the sonar could go over to the other ones.

And my take on it has been that NAVSEA has tried to talk about common chassis, for instance, more cutting across.

But I have also wondered about industry just saying, "Well, do you really need that rearview mirror up there, where you push the button"—and you know the example I am going to give—"and, boy, it just automatically, if some light comes in, focuses itself—do we really need that?"

And the thing about bulk buying and stabilization is that we have been there. But the other thing about designing for production and things like that, isn't that where industry really has a hand to help us, if we get them inside the room, to much better bring this cost into something that is aligned along the ideas of what I understand NAVSEA has talked about, of there are maybe only three common chassis or something for our future.

Do you know what I am talking of?

Admiral SULLIVAN. Yes, sir. We need more of that. I think we explored that to a great distance when we worked on the design of the *Virginia*-class.

That was industry driving the government, "Do you really want to buy this," for instance, "hydraulic valve that is a one-of-a-kind valve, has a very stringent acoustic and shock requirement, when its commercial equivalent made on the bench next-door costs one-fourth the same cost, and if you can just figure out a way to design it into the ship a little bit better, you can buy the cheaper valve?"

And we went a long way down that road. We need to continue that across all of our classes and allow industry to drive us more.

Mr. SESTAK. Could I ask the following? Can I get a copy, if you have, what are these meetings you are talking about, so I have an idea of a little bit more the formality of it and the participants?

Because I know there are these informal ones and getting together, but these studies have been going on for quite some time. And then you have whatever, every ship class. I don't mean just LCS, but it has almost become an issue.

And I am curious about how far those have gone down the road in the sense of bringing it together, if you didn't mind providing that.

Ms. STILLER. Absolutely no problem. Would be happy to.

Mr. SESTAK. The only other question, which—Aker Shipyard would be Philadelphia. Do you find what they have done up there in Aker Shipyard is of some potential where the cost of the ship has gone down from 13 times what they would make it overseas to, potentially, with the new buy, down almost three or four more ships, one to one, because of how they have gone about their buy as a model?

Are you familiar with Aker?

Ms. STILLER. I am. I have not visited the yard, but I am familiar with their model. And it is like what you see in most yards in the European yards and in the Asian shipyards. It is volume-dependent. And, also, they are able to leverage their buys not just in the U.S. but internationally, as well.

And, Admiral Sullivan, maybe you——

Admiral SULLIVAN. I have been there. And they build vastly simpler ships than the Navy builds to a standard, proven design with zero change environment.

Mr. SESTAK. I guess my question was more of the investment that they put in to do it like they do in Korea. That is more what I was taken with. They made a decision that what was going to built, the right toolings and everything would be there, that initial upfront investment. I thought that is what really drove them down, not just the bulk buy. Because, up until recently, they had gotten

down to two or three times the cost, but that has only been with two or three ships.

But it has been that investment. And I gather it might not be, but I would have to—not too dissimilar to what we do for aircraft, when we decide to build a new F–22, but there is that initial investment in the infrastructure to make sure that you have the correct toolings in order to then go off and build the ship.

Admiral SULLIVAN. Yes, sir. I would agree with that, and they did make that investment upfront, and it has paid dividends.

Again, though, when the principal function of the shipyard is to assemble steel plate and one or two standard sizes of pipe with one or two standard sizes of fittings, you are talking an order of complexity about one-hundredth of what you are talking about for a warship.

And the same thing goes for the aircraft industry. And I know the airplanes cost a lot of money, but the jigs and fixturing that are put together to go do a long production build of many, many units in an aircraft are somewhat translatable to our part of the business. And we need to keep working on that.

But I would caution that there is so much, I will call it, custom work in a warship that, if you are only building, let's say, six or seven of a class or even 10 to 15 of a class, you can't get the economic rate of return that you can because it is so complex and because the production run is small and because there are large, long distances in time between each ship and the next.

Mr. SESTAK. Admiral, then what does it say about the prospects for achieving nirvana of trying to have these costs be something that would permit us to afford a 308-ship Navy? I mean, if that is the case, are we really just whistling in the dark?

Admiral SULLIVAN. I don't think we are whistling in the dark. We need to continue with all the things we have discussed here today.

But in even those most efficient yards that we have visited, the cost of their combatants is about the same as the cost of our combatants, even the yards that the Philadelphia yard cannot compete with. In their commercial business, they are number one in the world, let's say, but their warships cost the same as our warships.

Mr. SESTAK. But the Congressional Budget Office (CBO) says that the cost of our shipbuilding program will be 35 percent more than what we estimate, based upon how we have always done things. Is that realistic?

I mean, we predicate our ability to have that size fleet based upon no increase in cost of what we have estimated for the fleet.

Many of these issues here are ones that have been around for a decade or so. I mean, do you think we have got it now?

Admiral SULLIVAN. Let me talk about the CBO estimate.

The CBO—and we talked to them; we passed them our numbers and our assumptions. And a lot of this has to do with how do you budget for risk. The CBO doesn't have to budget for a shipbuilding program that has to also be balanced with an aviation program, with personnel and with fleet operations. So when they do their calculations, the range of costs that they see for our ships, they will do that on the conservative side.

The Navy necessarily budgets to a much more aggressive number than what the CBO is, and I think that is the difference.

Mr. SESTAK. Aggressive means optimistic?

Admiral SULLIVAN. No, I would say more aggressive. The CBO tends to go toward worst-case analysis. If the Navy budgets for the worst case, that is hard to do across everything that you are buying in the Navy on a given year.

Mr. TAYLOR. Admiral Sestak, I hate to do this, because this is a great line of questioning. Unfortunately, we have a hard stop in 28 minutes, because the full committee will be meeting.

Mr. SESTAK. That is fine.

Mr. TAYLOR. And so, in fairness to the next panel.

Mr. SESTAK. Thanks very much.

Mr. TAYLOR. We want to thank this panel for being with us today.

The chair now calls the second panel: Mr. Mike Toner, Executive Vice President of Marine Systems Group of General Dynamics; Mr. Phillip Teel, the President of Northrop Grumman Ship Systems; Ms. Cynthia Brown, the President of the American Shipbuilding Association; and, Dr. Mark Montroll, Ph.D., Professor of the Department of Acquisition at the National Defense University.

And we want to recognize a number of his students that are here with us today. And thank you for being with us.

Ms. Brown, are you going to be first?

Ms. BROWN. That is fine.

Mr. TAYLOR. If I could, Ms. Brown, I hate doing this to you, but we really do have a hard stop now in 27 minutes. So if we could limit each of you to six minutes. That way you can get your statement in, and we will supply written questions for the record.

Ms. BROWN. And, Mr. Chairman, please give me a high number when the six minutes is up here.

Mr. TAYLOR. Okay. The machine is on.

Ms. BROWN. I will try to be brief.

Mr. TAYLOR. The chair recognizes Ms. Cindy Brown of the American Shipbuilding Council.

STATEMENT OF CYNTHIA L. BROWN, PRESIDENT, AMERICAN SHIPBUILDING ASSOCIATION

Ms. BROWN. Let me begin by thanking you for this hearing.

Persistently low and unstable rates of Naval ship production have taken a tremendous toll on the shipbuilding industrial base that is vital to our national defense.

Let me just say that, in 2001, we had a fleet of 341 battle force ships. It has now plunged to a 90-year low of 276 ships today.

This has given tremendous challenges to our shipyards in trying to manage the schedule, workload, and to sustain their skilled engineering workforce, their production workforce, and having the ability to make investments in their facilities and processes, and in managing the day-to-day operations of their business.

Put simply, there is no substitute for volume production in reducing the cost of every ship we build and maximizing capital investments by the industry.

Even though we have struggled in a very anemic production environment, these shipyards have made major investments, large investments in their capital and their facilities.

I will name just a few examples, where over a billion dollars in recent years has been invested. These investments include automated design tools, covered facilities, automated steel cutting facilities, facilities for constructing larger modules, cranes for increasing lift capacity for larger modules, laser cutting equipment, state-of-the-art panel lines, new and expanded power grids, and heavy moving equipment, just to name a few.

If asked, every shipbuilder would tell you that more capital investment in processes and facilities would increase efficiency and further reduce cost.

Their ability to do so, however, depends on their cash flow, work projections and profits to demonstrate a return on such investments to their corporate parents. The current business environment for shipbuilding makes the corporate return-on-investment business case very difficult to make.

Corporate investment dollars favor the facilities that have the largest profit margins and that show the growing order book. Where shipyards may not be able to make the corporate return-on-investment business case, there are many investments that could be made in the shipyards that would show a very favorable return on investment to the government.

To make such investments possible, the American Shipbuilding Association (ASA) asks you to consider legislation that would require the Navy to expand the use of special incentive fees in all Navy shipbuilding contracts for the purpose of investing in facilities and process improvements where such favorable returns on the investment are there for the Navy.

The legislation we ask you to consider is a modified and expanded version of the current capital expenditure program, or CAPEX for short, that has been included in the *Virginia*-class contract that you discussed today. I won't describe it further; I will give you just a couple of examples.

An incentive fee award of $7 million to Newport News Shipbuilding to invest in a second modular outfitting facility will result in estimated savings of approximately $34 million in the construction costs of the *Virginia*-class program. An investment of $9 million by Electric Boat in a new coating facility at its Quonset Point shipyard will save an estimated $140 million in the program.

We commend the nuclear Navy for their efforts to expand incentive fees for capital investments.

ASA recommends that the Navy include, in all of its programs, money for incentive fees for the purpose of capital investments if the contractor makes a business case that, number one, the savings through changes in the design, material use, technology or production process would result in savings in the ship program or, two, a proposed investment itself would result in savings in the shipbuilding program or programs.

The proposed legislation recommends a 2008 authorization of $100 million as seed money for incentive fees across all shipbuilding contracts. It would require the Navy to report back to you no later than May 1 of 2008 on how the Navy has distributed or plans

to distribute the $100 million provided in fiscal year 2008 for specific capital expenditures by a shipbuilding program.

And it further provides that the Navy would annually budget money in its shipbuilding programs to provide incentive fees for the purpose of the capital investment beginning in fiscal year 2009.

Funding requested for incentive fees for this purpose would be required to be identified by the Navy by ship program, concurrent with future budget submissions to the Congress.

The legislative proposal would reduce the cost to the Navy by emphasizing designs that translate into ships that are easier to produce, as you talked about today, helping to control non-value requirement changes that add costs but are not operational necessities, and reducing the cost of ships for target investments.

I would like to also bring to your attention another practice which is hurting our efficiency, and this is where the Navy is withholding and retaining payments owed to the six shipyards.

Today, day-to-day operations, cash flow is essential to operating the business, as well as to paying your vendors in a timely fashion. Today, more than $300 million is being withheld or retained in payments that are owed to the six shipyards in compliance with the terms of their contracts.

I would ask that the committee direct that the Navy cease this practice so that that money can be there and available so that all the shipyards can operate more efficiently and pay their vendors in a timely fashion.

I am asked often, "Why don't the shipyards go to court?"

Mr. TAYLOR. Ms. Brown.

Ms. BROWN. Okay.

Mr. TAYLOR. We very much appreciate your statement.

Ms. BROWN. Thank you.

[The prepared statement of Ms. Brown can be found in the Appendix on page 52.]

Mr. TAYLOR. Who would like to go next?

Mr. TONER. I would like to.

Mr. TAYLOR. Okay, Mr. Mike Toner.

STATEMENT OF MICHAEL W. TONER, EXECUTIVE VICE PRESIDENT—MARINE SYSTEMS, GENERAL DYNAMICS CORPORATION

Mr. TONER. Thank you, Mr. Chairman and members. I am Mike Toner. I am the Executive Vice President of Marine Systems for General Dynamics.

I want to thank especially yourself, Mr. Chairman, and former Chairman Bartlett for the time that you spent in our shipyards in August this summer. I think you saw a number of the things that we are going to talk about.

I have provided a written testimony for the record, but I would like to go and talk about three basic items.

I think there are some slides that I have asked that you have and take a look at.

And if you could look at the first one, which is identified as the global shipbuilding industrial base slide, this comes out of the FMI study, which was provided to Congress, like I said, in the first part of January 2006.

If you look at this chart, it is in four basic sections. The first section is steel work. The second section of three areas is really the outfitting, manufacturing and erection, that is the delivery of the ship. The third section is the shipyard layout. The fourth section is how you engineer and plan and how you procure material, et cetera.

If you look at the majority of these things—the General Dynamics shipyards, which are in green; the U.S. average shipyards, which are in yellow, which is the compilation of both the General Dynamics and the Northrop shipyards; and the international yards, which is in gray—it pops out to you right away that the process that we use for outfitting, manufacturing and delivering ships were either world-class or equivalent to them anyway in that aspect.

And that is our philosophy of driving work to the left, getting the ship complete, minimizing the time in the water, and getting it to sea and ultimately delivered.

There are two areas where we are a little bit behind.

One is the steel work area, which you would expect in the submarine yard, where we don't have a lot of steel, per se. It is big, it is bulky, but it is not plate forms and shapes. Our issue there is to go work at NASCO to improve that part. And we have made significant improvement in that area from 2000. We are not quite there yet, and there is more happening in there.

Significantly, in the yard layout, you would expect the three General Dynamics yards, which are very small yards relatively speaking, that that would be the issue. In reality, the numbers would show you that the Bath and Electric Boat yards are equal to or equivalent or better than world-class. The NASCO yard, however, is far behind. And that is where we are focusing in NASCO.

When you were out there in August, you saw some pieces moving around, and we were looking for space. Well, we have knocked down a bunch of buildings. We are getting more space, and we are making space for our blocks as we prepare to do commercial work.

At the end of the day, the three yards: Electric Boat is in a low rate of production. We are trying to get to two submarines a year. BIW has low rate of production coming on with DDG–1000. NASCO, we have a commercial project in-house of five of what we sell, PC–1 product carriers, and an option for four others, so a potential of nine ships.

Low rate production, by its nature, develops the CAPEX program, and you have heard about the CAPEX program from the submarine side. It is a program that is good. It has worked for us at Electric Boat, and a form of it we used up at BIW in order to put into the ultra hull.

I would ask that you turn to the next page, which is an interesting document in that it shows the amount of labor hours versus material in each of the three major projects that I have in the shipyard.

The labor hours and investments that we have made in material—oh, by the way, since the late 1990's to today, we have invested over $600 million in these shipyards. That is equivalent to about 25 percent of the earnings that we made in those shipyards over that same period of time.

Each one of these projects, we have taken at least a million man-hours out of the ship construction; in the case of *Virginia*, 2 million; in the case of T–AKE, about 1.2 million on the first or second ship; and on DDG–51, from the first ship on the land level facility to the ship that we are building today, it is about 1.5 million to 1.6 million.

The interesting thing here is that the material is the major portion of this program. What we just talked about was what we did in the shipyard labor side. The material portion is a big chunk of the business.

I ask you to go to the next slide, and you look at the standard chart that you see a number of times that has the shipbuilding budget over the last three decades.

I would ask you not to look at that, but to instead look at the line between 1983 and 1995. Take out the two blips, the two peaks, and you see what is happening to our vendor base. Our vendor base is deteriorating. It has been deteriorating for a long period of time.

We go into the 1990's, low rate production exists. We go into the late 1990's and start of the 2000s and we have lead class ships coming on, high material, high labor use, because the labor hours go up on the first of a class ships. And the number of first-of-a-class ships that we have seen is uncharacteristically high for this timeframe. And, as a result of that, you see the costs skyrocket up.

The issue here, as we get past the first-of-a-class ships, we will control the hours. Our issue is going to be, what do we do with the vendor base? And I think there are three things for it.

I think stability has started. We have only got a year, year and a half of it, but it looks like it is going to start.

I think you have a method to measure the ability of the yard in the studies that we do, in the benchmarking processes. And I think you have a way to incentivize us if we are in low production. But we need volume, and we have to work together to work that volume to get that vendor base back.

Those are my comments, all I have to say, and thank you for your time.

[The prepared statement of Mr. Toner can be found in the Appendix on page 82.]

Mr. TAYLOR. Mr. Toner, thank you very much.

Mr. Phillip Teel, Northrop Grumman Ship Systems.

STATEMENT OF PHILIP A. TEEL, CORPORATE VICE PRESIDENT, NORTHROP GRUMMAN CORPORATION AND PRESIDENT, NORTHROP GRUMMAN SHIP SYSTEMS, INC.

Mr. TEEL. Thank you, Chairman Taylor, Ranking Member Bartlett. I appreciate being here today.

And today I represent all of Northrop Grumman's corporate shipbuilding capability, Newport News and Ship Systems.

I have submitted a written statement for the record, and I would ask that be included in the record.

Mr. TAYLOR. With unanimous consent.

Mr. TEEL. Before I talk specifically about modernization, I want to make a couple of points that I believe are important and germane.

Obviously, we believe, and as the others have testified today in your line of questioning and discussion, that the objective is to build ships with capabilities that meet the Navy and Coast Guard's requirements, but at a lower cost than we are building them today. Sometimes, frequently, we, I think, think about our objectives being different. And we certainly want to focus on just that.

Another issue is I really believe we need to recognize that facility modernization alone will not achieve the objectives. A major portion of it, but that alone won't do it. And some of it has been touched today, and I will try to touch on that some more.

It has to occur in combination with process changes: process changes that we in the shipyards make and process changes that we make in conjunction with our customers and, in some cases, process changes that we make in conjunction with our customers and Congress.

And, again, some of those have been talked about today, and I will cycle back to that a little later.

We have done a very detailed analysis of commercial shipbuilding around the world, as I know you have. We have had several of our people, over the course of the last few years, spend time in these shipyards, as Ms. Stiller mentioned.

We have also hired FMI directly after the storm to work with us arm-in-arm, actually using the study that Mr. Toner referred to as the mechanism to begin to look at how we would improve our capability relative to the benchmark location we found ourselves compared to foreign commercial yards.

In the process of that analysis—and we would, at any time, be more than happy to share that with the entire committee—what we have come to learn is that commercial shipbuilders have an intense focus on design for production.

In addition to all of the facilitation that is apparent and automation that is apparent through any walkthrough, they also are very focused on cost-effective designs, reduced complexity through the whole of the shipbuilding system, from the vendor base all the way to the ship in the water.

That notion of design for production dominates the global commercial market. It is not apparent in the U.S. military market.

Commercial builders focus on design for production results in standard designs, proven systems and subsystems, standard components and parts, and limited customization.

To illustrate, and Admiral Sullivan mentioned it earlier, if we just look at the different part types, there are at least ten times the number of part types in a surface combatant that you will find in a commercial vessel and you can go through every system and subsystem in the ship and find the same thing.

Second, most commercial suppliers produce a much greater number of ships. Much has been said about that. Obviously, we don't see that happening in Navy shipbuilding, but I will talk some more about how that applies later.

And not only are the numbers greater, but, also, the cycle times are much shorter, the intervals between ships within a given class build.

The DDG program, for instance, within our yard, the average interval is about 200 days between units, with as much as 400 days between units. Best in class commercial yards, it is about 40.

Now, clearly, volume drives that, but I think there are other issues that can deal with that, as well.

That combination of standard capabilities, standard parts, standard everything, combined with far fewer changes, which is the third item, in the case of commercial ships, you may see 240 changes between the first ship of a class and the second. Within our LHD program, between number one and number two, there were 3,500 changes. And between that ship getting to the—from the time it was designed until the first ship was in the water, there were 5,700 changes. You may see 240 in a commercial ship and only two from ship to ship.

So between those three different items, the facilitization of automation fits the commercial world so much better than it does the world that we operate in.

Now, the results of the lessons that we have learned from our activities in the commercial yards tell us that we have got to develop techniques and we have learned some of those techniques from those shipyards and we have begun to put them in place as we redesign our yards on the Gulf Coast.

Those things can only go so far, and we strongly recommend that there be, as Congressman Sestak mentioned earlier, a very focused effort between the U.S. Navy, Coast Guard, the Congress and the shipbuilders, which would include some from the vendor base, to actually begin a detailed focus, not study, we know the items that need to be addressed, to look at how we address those items to bring some of that change and variability out of naval vessel systems.

[The prepared statement of Mr. Teel can be found in the Appendix on page 67.]

Mr. TAYLOR. Thank you, Mr. Teel.

The chair now recognizes Dr. Mark Montroll, professor at the National Defense University.

STATEMENT OF DR. MARK L. MONTROLL, PROFESSOR, INDUSTRIAL COLLEGE OF THE ARMED FORCES, NATIONAL DEFENSE UNIVERSITY

Dr. MONTROLL. Chairman Taylor, Representative Bartlett, I am a professor at the Industrial College of the Armed Forces National Defense University.

I have served as the director of the shipbuilding industry study class for the past nine years. I am delighted that my current class could be here today to be part of this important hearing.

Each year, the class's task is to study the industry and assess its ability to support our national security strategy requirements. This has given me an opportunity to observe shipbuilding practices throughout the world.

The most striking difference that I observe among shipyards are their physical size, use of automation and proximity to their supplier base. It is often the combination of these three elements that give shipyards their competitive advantage in the global marketplace.

World-class shipyards tend to optimize around high-volume, low-cost production processes. Production processes and practices that make commercial shipbuilding extremely efficiently are not always the best choices for the construction of warships.

While each new commercial ship may have unique, leading-edge interior design features contributing to commercial differentiation, the basic hull and machinery systems tend to be mature technologies. And once the purchase contracts are signed, the owners rarely request engineering or design changes.

Warships present a higher level of complexity than even the most elaborate commercial cruiser cargo ships. Tightly integrated, leading-edge weapons, sensors, fire control and communications systems, coupled with ship, crew and system survivability, as well as ship maneuverability, sea-keeping and station-keeping, provide the strategic advantage to warships operating in the battle space.

The necessity to simultaneously integrate and balance all of these attributes contributes to the inefficiencies associated with construction of warships.

The battlespace is constantly evolving, and if ships under construction are not able to keep up with real-world requirements, they may lose their competitive edge even before they are placed into action.

It is unreasonable to expect or desire that the Navy will ever produce a cluster of ships that are absolutely identical and for which no changes are allowed during the construction process. It would, therefore, seem to make sense to promote a design and construction process that acknowledges that changes will be made and efficiently accommodates them.

As the best and newest shipyards in the world continue to become more and more efficient at mass-producing high-volume, low-cost, standard-design ships, U.S. shipbuilders have an opportunity to set the world standard on mass customization of low-volume, reasonable-cost, flexible-design ships.

Although the combination of low volume, reasonable cost and flexible design would have been impossible to achieve even a decade ago, in today's modern, networked world, the theories, tools and processes exist to make this a reality.

The shipyards cannot do this alone. The infrastructure investments necessary to achieve this goal can be justified across the Navy's shipbuilding enterprise, but may not be justified across any single ship contract or single yard's expected order book.

While my class was analyzing the global shipbuilding industry last spring, another one of the Industrial College's seminars was analyzing the state of advanced manufacturing around the world. In their report, they wrote, "To ensure that the Department of Defense (DOD) leverages the private sector's investment in manufacturing technology, policymakers should apply digital thread technologies to all DOD system acquisition programs which link all aspects of the system together from computer-aided design to computer-aided manufacturing to operations, support and logistics."

This is precisely the path I am suggesting we pursue.

When I spoke before this subcommittee last year, in response to the questions asked of me, I suggested that in order to stimulate and stabilize the demand for U.S.-built ships, we should fund the

Chief of Naval Operations (CNOs) long-range plan for construction of naval vessels in a stable fashion, support the U.S. Maritime Administration's (MARAD) shipping initiative, and fund their Title XI and other Federal ship financing programs.

I continue to stand by these suggestions and am delighted to see that there has been great progress in stabilizing the Navy's shipbuilding plan.

If we also invest in the production infrastructure that enables our shipyards to set world standards for mass customization in shipbuilding, our Navy will continue to operate the finest, most advanced ships the world has ever seen. Our sailors deserve no less.

Thank you very much for allowing me to be here today. I look forward to your questions.

[The prepared statement of Dr. Montroll can be found in the Appendix on page 122.]

Mr. TAYLOR. Thank you.

The chair yields to the gentleman from Maryland.

Mr. BARTLETT. When I look at the first chart, global shipbuilding industrial base, and deficiencies only in two areas, steel work and yard layout, I might conclude that, with a little improvement there, that we ought to be able to compete globally. Or is process not included in these?

Mr. TONER. Process is, sir, in there.

Mr. BARTLETT. So what this says is, then, is that if you improve your yard layout and your steel work, you should be able to compete internationally.

See, we represent 25 percent of the world's economy. We represent essentially none of the world's commercial shipbuilding.

When I drive into work, I see Komatsu and Hitachi heavy earth-moving equipment competing side-by-side with heavy earth-moving equipment made in this country. I drive down the road and I see foreign-made and American-made automobiles. If we can compete in heavy earth-moving equipment and in automobiles, I am not ready to admit that we can't compete in shipbuilding.

We are the most creative, innovative society in the world, and, Mr. Chairman, we just ought to be able to compete, and there isn't any reason that we shouldn't.

We compete in these other areas, and we ought to be able to compete in commercial shipbuilding. And to the extent that we can do that, the necessary upgrade of our yards will then be something that the chairman of the board can readily promote.

But how do we get over this hurdle? Because what this graph tells me is that, with a little improvement in those two areas, you are as good as anybody in the world. Is that right?

Mr. TONER. That is right.

Mr. BARTLETT. So, then, why can't we compete commercially with anybody in the world?

Mr. TONER. The fundamental problem is there isn't the volume and the cost of material. If you look at my yard today that is doing commercial work probably in man-hours a factor of three higher than what some of the international yards for a similar-type ship.

Now, I think I can get that down, and we will work that through process and some facilitization that we are doing. And it is part of the layout process. But the fundamental reason remains that the

foreign national yards will produce a ship for what it cost me for material. I haven't figured out how to do it with nobody.

Mr. BARTLETT. The Chinese are planning to build, what, the largest shipyard in the world, and as of now, they have no customers. And I suspect that when they build that shipyard, they will be able somehow to acquire the customers so that they will have the base so that they can purchase the steel and so forth at competitive prices.

How are they going to be able to do that and we can't?

Mr. TONER. We don't have the volume of ships to build.

Mr. BARTLETT. They will?

Mr. TONER. If you went back into the early 1980's, prior to the removal of subsidy for shipbuilding, we built about 10 percent of the world's ships and a few years back, that was about 2,000 ships a year and 10 percent would have been 200 ships. Could you imagine what 200 ships would mean for this industry?

Mr. BARTLETT. We would be in hog heaven, wouldn't we?

Mr. TONER. How about 25 ships?

Mr. BARTLETT. I understand.

Mr. TONER. That is where it is. And my concern is the activities that we have put in place, that Phil and I talk about, we will get the hours down, we will get the hours to where they are going to be. The problem is going to be the vendor base behind us, the material. And you need volume to go get that.

I don't have a magic pill for that. I don't know. I need more ships; I guess that is the name of that tune.

Mr. BARTLETT. The Chinese have nothing now, and they are going to build the biggest yard in the world.

Mr. TONER. The Chinese are building ships now, and they don't have nothing.

Mr. BARTLETT. We went to their shipyard, and, I will tell you, they pay their people $5,000 a year and they have essentially no automation. They were swarming over that ship that was vastly different from the one in South Korea.

And they were losing money, by the way, and he didn't seem all that distressed by it. He was kind of smiling when he mentioned how much money they were losing because the price of steel went up.

Mr. TONER. Well, we are not really in the business to lose money. I don't think that is something that you want us to do.

Mr. BARTLETT. I guess in a socialist system, it doesn't matter.

Thank you, Mr. Chairman.

Mr. TAYLOR. In the brief time remaining, the chair yields to Admiral Sestak.

Mr. SESTAK. I guess my question, sir, is, without the volume, can you continue to make a profit?

I mean, it is not——

Mr. TONER. Well, this is for my yards, I can speak for my yards, okay. We have been, since the middle–1990's, if you looked at that third chart—and I believe you were out of the room at the time.

Mr. SESTAK. Yes, sir, I apologize.

Mr. TONER. But that third chart, we went into what we call low rate production. We have been at low rate production for submarine facilities for a number of years. The only repair for that,

or the fix, is to get to two submarines a year. And I think we are very close to being in that arena.

The commercial yard that I have out at NASCO is—we went through a very difficult time in bridging—between the late–1990's to the start of the T–AKE, we took on some commercial work and we took on two tote ships, which are like row-rows for Alaskan trade, and four large oil tankers——

Mr. TAYLOR. Mr. Toner, I very much apologize, but under the rules of the House, this subcommittee cannot meet while the full committee is meeting, and the full committee just began a meeting.

So I am going to have to cut you off. We do very much appreciate your being here.

Mr. TONER. Thanks for your time.

Mr. TAYLOR. We very much regret that this second meeting was called after this meeting was already scheduled, but we have to abide by the rules of the House.

The subcommittee stands adjourned.

[Whereupon, at 4:33 p.m., the subcommittee was adjourned.]

A P P E N D I X

March 20, 2007

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

MARCH 20, 2007

NOT FOR PUBLICATION UNTIL RELEASED BY THE
HOUSE ARMED SERVICES COMMITTEE
SEAPOWER AND EXPEDITIONARY FORCES
SUBCOMMITTEE

STATEMENT OF

VADM PAUL SULLIVAN, U.S. NAVY
COMMANDER, NAVAL SEA SYSTEMS COMMAND

and

MS. ALLISON STILLER
DEPUTY ASSISTANT SECRETARY OF THE NAVY
(SHIP PROGRAMS)

and

RADM DAVID ARCHITZEL, U.S. NAVY
PROGRAM EXECUTIVE OFFICER, AIRCRAFT CARRIERS

and

RDML WILLIAM HILARIDES, U.S. NAVY
PROGRAM EXECUTIVE OFFICER, SUBMARINES

and

RDML CHARLES GODDARD, U.S. NAVY
PROGRAM EXECUTIVE OFFICER, SHIPS

BEFORE THE

SEAPOWER AND EXPEDITIONARY FORCES SUBCOMMITTEE

OF THE

HOUSE ARMED SERVICES COMMITTEE

ON

SHIPYARD MODERNIZATION AND COST REDUCTION MEASURES FOR SHIPS

MARCH 20, 2007

NOT FOR PUBLICATION UNTIL RELEASED BY THE
HOUSE ARMED SERVICES COMMITTEE
SEAPOWER AND EXPEDITIONARY FORCES
SUBCOMMITTEE

United States Navy Biography

Vice Admiral Paul E. Sullivan
Commander Naval Sea Systems Command

A native of Chatham, N.J., Vice Admiral Sullivan graduated from the U.S. Naval Academy in 1974 with a Bachelor of Science degree in Mathematics.

Vice Adm. Sullivan served in *USS Detector* (MSO 429) where he earned his Surface Warfare Qualification. After transferring to the Engineering Duty Officer Community, he served at the Norfolk Naval Shipyard, Naval Sea Systems Command, Supervisor of Shipbuilding in Groton, Conn. and on the staff of the Assistant Secretary of the Navy (Research, Development and Acquisition). During his engineering duty assignments Adm. Sullivan earned his Submarine Engineering Duty Officer Qualification.

Vice Adm. Sullivan holds dual degrees of Master of Science (Naval Architecture and Marine Engineering) and Ocean Engineer from Massachusetts Institute of Technology.

Vice Adm. Sullivan served as program manager of the *Seawolf*-class Submarine Program (PMS 350) and the *Virginia*-class Submarine Program (PMS 450).

Upon selection to flag rank, Vice Adm. Sullivan served as Deputy Commander for Ship Design Integration and Engineering, Naval Sea Systems Command from 2001 to 2005.

Vice Adm. Sullivan became the 41st Commander, Naval Sea Systems Command in July 2005.

ALLISON F. STILLER
DEPUTY ASSISTANT SECRETARY OF THE NAVY
(SHIP PROGRAMS)

Since January 2004, Ms. Stiller has been the Deputy Assistant Secretary of the Navy for Ship Programs, responsible for executive oversight of all naval shipbuilding programs, major ship conversions and nuclear refueling, and the maintenance, modernization and disposal of in-service ships.

Prior to her current assignment, Ms. Stiller served as the Deputy Program Manager in the Amphibious Warfare Program Office (PMS 377), responsible for design, development, acquisition, and fleet introduction of amphibious ships and landing craft. Previously, she was the Director for Naval and Commercial Construction in the Office of the Assistant Secretary of the Navy for Ship Programs, responsible for oversight of amphibious and auxiliary ship construction and conversion programs, as well as shipbuilding industrial base matters.

Ms. Stiller is an alumnus of the Commander's Development Program. She completed short-term rotational assignments from 1994 to 1997 in various offices, including the Office of the Assistant Secretary of the Navy for Ship Programs, Office of the Secretary of Defense (Acquisition and Technology), Capitol Hill, Supervisor of Shipbuilding (Pascagoula, MS), and the Maritime Administration.

Ms. Stiller's previous assignments have included Acquisition Manager for the New Attack Submarine Program; SEAWOLF Combat Systems Mechanical Branch Head; and private industry supervisor supporting TRIDENT submarine engineering and logistics efforts.

Ms. Stiller holds a BS in Systems Engineering from the University of Virginia and a MS in Engineering Management from Virginia Tech. She is also a graduate of the JFK School of Government's Senior Executive Fellows Program at Harvard University.

REAR ADMIRAL DAVID ARCHITZEL
United States Navy

Program Executive Officer
for
Aircraft Carriers

Born in Ogdensburg, New York and raised in Merrick, Long Island, Rear Admiral Architzel earned a Bachelor of Science degree in mathematics at the U.S. Naval Academy in June 1973. Concurrent with his designation as a Naval aviator in November 1975, he earned a Master of Science degree in aeronautical systems from the University of West Florida.

Rear Admiral Architzel served in VS-30, deploying aboard *USS Forrestal* (CV-59), and as Maintenance Officer in VS-28, deploying aboard *USS Independence* (CV 62). He later returned to VS-30 as XO and subsequently as CO. After selection to Nuclear Power Training, he served as XO of *USS Dwight D. Eisenhower*. During his tour, IKE was awarded the 1992 COMNAVAIRLANT Battle Efficiency Award. Following this tour, he served as XO of PCU *John C. Stennis*, and CO of *USS Guam* (LPH 9), flagship for Commander Amphibious Squadron Two. During this tour, *Guam* won three consecutive Battle Efficiency Awards, making deployments to the Mediterranean Sea and Indian Ocean, which included Adriatic operations in support of the US Ambassador to Somalia. He became the sixth Commanding Officer of *USS Theodore Roosevelt* on November 1, 1996. His command tour included a deployment to the Mediterranean and Arabian Gulf, during which time the Battle Group conducted operations in support of Joint Guard and Southern Watch.

Ashore, Rear Admiral Architzel was selected for the Navy's Test Pilot School, filled a critical billet at the Spanish Naval War College in Madrid, Spain, and was department head of the Warfare Systems Group at the Naval Air Test Center, Patuxent River.

Rear Admiral Architzel's first flag assignment was to Iceland, where he served as Commander Iceland Defense Force and Commander Fleet Air Keflavik. His follow-on flag assignments were Commander, Naval Safety Center, Norfolk Virginia, Commander, Navy Region Mid-Atlantic and Commander of Operational Test and Evaluation Force, Norfolk, Virginia. On 29 July 2005, Rear Admiral Architzel assumed command as the fourth Program Executive Officer for Aircraft Carriers.

Rear Admiral Architzel has accumulated over 5000 flight hours, 4300 in the S-3 and the remainder in some 30 other aircraft types. His decorations include the Defense Superior Service Medal, four Legions of Merit, three Meritorious Service Medals, the Navy Achievement Medal and various service related awards and campaign ribbons. He was also awarded the Spanish Naval Cross of Merit from His Majesty, King Juan Carlos of Spain, the Navy League's John Paul Jones Leadership Award for 1998, and the Commander's Cross with Star of the Icelandic Order of the Falcon presented by the President of Iceland.

REAR ADMIRAL WILLIAM HUNTER HILARIDES
UNITED STATES NAVY

RDML Hilarides was born in Charleston, West Virginia, and was raised in Chicago, Illinois. He attended the United States Naval Academy and graduated in 1981. Immediately after graduation, he served as master of the Naval Academy Sailing Squadron sloop Avenger, competing in numerous offshore racing events.

His shipboard tours include the USS PARGO (SSN 650) based in New London, CT, USS GURNARD (SSN 662) in San Diego, CA, USS MARYLAND (SSBN 738) in Kings Bay, GA, and culminating in command of USS KEY WEST (SSN 722) in Pearl Harbor, HI. During these assignments, RDML Hilarides deployed to the North Atlantic, Mediterranean, Arctic, and Western Pacific, conducted several strategic deterrent patrols, and underwent two major shipyard periods.

Shore tours include Aide and Flag Lieutenant to Commander Submarine Force, U.S. Atlantic Fleet in Norfolk, Virginia, Personnel Assignment Officer at the Bureau of Naval Personnel in Washington, D.C., Action Officer on the Joint Staff in the Force Structure, Requirements and Assessment Directorate, and Requirements and Acquisition Branch Head on the staff of the Chief of Naval Operations, where he served as the Navy representative to the Joint Requirements Panel.

Since becoming an Acquisition Professional, he has served as the Director, Advanced Submarine Research and Development (SEA 93R) and as the Conversion Manager and subsequently the Program Manager for the SSGN Program (PMS 398). He is currently the Program Executive Officer for Submarines.

RDML Hilarides' education includes a Bachelor of Science degree in Physics from the US Naval Academy, Navy Nuclear Power training, a Masters Degree in Engineering Management from the Catholic University of America, the Air Force Command and Staff College, the MIT Seminar XXI program in International Security Affairs, and level three acquisition training.

His personal awards include the Defense Superior Service Medal, the Legion of Merit (2), the Defense Meritorious Service Medal, the Meritorious Service Medal, the Navy Commendation Medal (5), and the Navy Achievement Medal.

United States Navy Biography

Rear Admiral Charles H. Goddard, USN
Program Executive Officer, Ships

Rear Admiral Goddard graduated from the United States Naval Academy in 1978 with a Bachelor of Science Degree in Naval Architecture. He also holds a Masters of Science and Ocean Engineer's Degree from the Massachusetts Institute of Technology (MIT).

Rear Admiral Goddard achieved Surface Warfare Qualification in USS ROBERT E. PERRY (FF-1073) where he served as Anti-Submarine Warfare Officer and Auxiliaries and Electrical Officer.

He became an Engineering Duty Officer in 1981. His engineering duty officer tours include: Pearl Harbor Naval Shipyard as Ship Superintendent, 1981-1982; Long Beach Naval Shipyard as Ship Superintendent and Type Desk Officer, 1986-1989; David Taylor Research Center as System Engineer for the Advanced Surface Machinery Program, 1989-1992; Naval Sea Systems Command as Surface Stealth Project Officer, 1992-1995, Supervisor of Shipbuilding San Diego as New Construction Officer, 1995-1998; Naval Sea Systems Command as Director of Ship Research and Development, 1998; and as Strategic Sealift Deputy Program Manager (PMS 385), 1999. Rear Admiral Goddard served as a CNO Fellow on the Strategic Studies Group from 1999-2000, Executive Assistant to Commander, Naval Sea Systems Command from 2000-2001; DD(X) Program Manager, 2001-2005; and as Vice Chief, Naval Sea System Command from 2005 to 2007. He assumed his present duties in February 2007. He is a member the Acquisition Professional Community and a graduate of the Program Manager's Course at the Defense Systems Management College.

Rear Admiral Goddard's personal decorations include the Legion of Merit, Navy Meritorious Service Medal (two awards) and Navy Commendation Medal (two awards). He is a member of the American Society of Naval Engineers and the United States Naval Institute. He is the author of several articles on the topic of ship design and construction.

INTRODUCTION

Mr. Chairman, distinguished members of the Seapower and Expeditionary Forces Subcommittee, thank you for this opportunity to appear before you to discuss the topic of Shipyard Modernization and Cost Reduction Measures for Ships.

First, we would like to thank you for your continued interest in naval shipbuilding and the future of our Navy. In particular, the discussions of shipyard modernization and cost reductions are vital for the capabilities of our Navy, and for our ability to acquire and support the Navy's 313 Shipbuilding Plan in a cost effective manner.

The Subcommittee asked that the Navy address how the private shipyards can modernize and become more efficient for new construction of Naval vessels. The primary focus will be on the March 2007 Assessments of Naval Vessel Construction Efficiencies and of Effectiveness of Special Contractor Incentives Report to Congress; however the testimony will also cover two other reports, which were delivered in late February 2007 and address shipbuilding efficiencies. These reports cover the Shipbuilding and Ship Repair Industrial Base and Ship Systems Commonality.

SHIPBUILDING/SHIP REPAIR INDUSTRIAL BASE CAPACITY

The US naval industrial base for new construction is composed of six major private shipyards sites, which constitute the first tier of naval construction; and several second tier shipyards that construct smaller naval vessels.

The Navy has initiated an aggressive investment strategy to build an affordable 313-ship fleet tailored to support the National Defense Strategy and the 2006 Quadrennial Defense Review. The Department plans to procure seven ships in FY 2008 for the US Navy, and we are serving as the executive agent for one Joint High-Speed Vessel for the US Army. As required by Congress, the Department of the Navy recently submitted its Annual Long Range Plan for Construction of Naval Vessels which reinforces the 313-ship fleet plan introduced last year. The FY 2008 Annual Long Range Plan for Construction of Naval Vessels represents the Department's commitment to stability and predictability which in turn minimizes disruption in shipbuilding and facilitates efficiency and effectiveness in our industrial base.

The Navy's FY 2008 new construction shipbuilding plan recognizes the need for aggressive requirements and cost control measures that can only be achieved in partnership with industry utilizing realistic assumptions within our ability to instill discipline in shipbuilding requirements and industry's ability to drive capital investments to reduce cost. Given the importance of requirements-containment and cost-reduction to the viability of the shipbuilding plan, the Navy continues to evaluate each ship class and identify cost reduction opportunities while balancing warfighting requirements, costs, and industrial base realities. Each of these three elements is inextricably tied to the other: changing requirements may result in cost changes which in turn may impact on the industrial base.

The DoN requires an industrial base which is reliable, cost-effective and adequate to meet the Nation's strategic objectives. Without stability, shipbuilders are not incentivized to invest in

facilities and labor improvements or reduce vessel costs. A stable, robust, funding profile is the primary factor necessary to sustain those industrial capabilities which support Navy shipbuilding. Such funding focuses market demand across a broad spectrum of industry segments to meet emerging and projected DoN requirements. The Navy's 2008 Annual Long Range Plan for Construction of Naval Vessels seeks to align the Navy's force structure to meet its operational requirements in terms of both capability and capacity, while encouraging competition. The three key aspects of the Navy's plan - requirements, cost, and stability provide the demand signal to industry. The Navy is addressing all three elements by developing a reliable and executable shipbuilding plan for the nation's shipbuilding industrial base.

Overall recommendations for managing the capacity of the shipbuilding industrial base require a partnership between the Navy, Industry, and Congress. The Navy can help to stabilize the industrial base by:

- Promoting acquisition strategies that enhance cost reduction such as multi-year procurement, block-buy, teaming for flexibility, open architecture and commonality;
- Encouraging facilities and process improvements through steady workload and a variety of contract incentives;
- Maintaining a level workload to provide the best opportunity for increasing efficiency and effectiveness; and
- Matching the most experienced people to shipbuilding programs with highest risk.

Shipbuilders should:

- Benchmark off of the best of European, U.S. and Asian shipbuilding practices and adopt the best strategies to increase efficiency;
- Buy common components wherever possible;
- Reinvest profit towards shipbuilding advancements and new technology;
- Ensure ship progressing metrics are correctly reported;
- Apply lessons learned across shipbuilding programs; and
- Investigate bulk purchases of commodities such as steel and copper.

The Congress can help with:

- Supporting stability in the shipbuilding plan;
- Providing multi-year procurement authority, when requested;
- Allowing flexibility of funding for cross-class component purchases; and
- Encouraging and creating incentives for commercial work at U.S. shipbuilders.

SHIP SYSTEMS COMMONALITY

The Navy has a number of initiatives and processes in place to capture commonality benefits for the Current Navy and the Next Navy. These include commonality addressed at the ship level, at the system level, at the material level, and in processes. For instance, in the current Navy, commonality is enhanced through commodity contracts across multiple platforms; parts commonality; common processing and display systems; modularity; Open Architecture; and software reuse.

For the Current and Next Navy, we plan to increase commonality as part of the 2008 Annual Long Range Plan for Construction of Naval Vessels. This will be done by reducing the number of ship types; utilizing existing Navy systems on new designs; using adaptive infrastructures to allow technology to evolve without a physical impact to the ship; leveraging commercial technology; increasing modularity; increasing Open Architecture; adopting Class Common Equipment (CCE); and developing a common specification for an integrated product data environment (IPDE). The goal of all these initiatives is to minimize variance within the systems to reduce cost, schedule, and risk. Overall, the Navy is moving towards a warfighting capability-based approach rather than platform-centric approach. This means that Navy develops specific capability and functionality for use Enterprise-wide vice expending additional resources developing multiple systems that provide the same capability but are targeted to one class of ships only.

For the Next Navy, we are addressing commonality in several ways. At the highest level, reducing the number of ship hull types will reduce the number of unique systems in the fleet. Naval Sea Systems Command (NAVSEA) evaluated reducing the number of overall hull types beyond current shipbuilding plans and concluded that the Navy can potentially reduce hull types but decisions would have to be balanced with future threat analyses to examine a feasible timeline for implementation and the correct mix of capabilities. By reducing the overall number of hull types, there may be potential for vast reductions in the number and types of Hull Mechanical and Electrical (HM&E) components in the Fleet. This could reduce life cycle logistics costs, including the procurement of technical data, training, and supply support associated with the procurement of new equipment. Similarly, there is the potential to reduce procurement cost as compared to the current long range plan, because non-recurring costs are reduced by reuse of already approved designs. Test and Evaluation savings could also be realized, if common products were tested once vice on every platform. The Navy has devised an Enterprise Test and Evaluation strategy to eliminate redundant testing of common systems, which is being implemented. In order to achieve this commonality, the Navy must lead a forum on common components, revised specifications, and revised standards.

Regardless of the number of ship hull types, however, open systems architecture and modularity can also support commonality of ship systems. The Navy plans to reduce the number of combat systems baselines from sixteen to five by 2025, through the use of decommissionings or Open Architecture. Although modularity has been explored at a program level, the Navy could fully evaluate the cost advantages of modularity by considering the entire Navy program plan.

Finally, the Next Navy can address commonality through ship design processes. NAVSEA also identified four areas of the ship design process where commonality and interoperability are recommended:

- Product data interoperability.
- Concept and feasibility design tools.
- Technical Warrant Holder tools for certification of designs.
- Design community tools coordination.

Future work will examine modifications to these processes to enhance commonality.

In order to implement any of the solutions outlined in this report, the Navy needs to examine a corporate strategy and develop a uniform approach for ship system commonality, which may include Analysis of Alternatives, determining requirements document inputs and corporate cost savings tracking through captured metrics. A cross-program approach, analogous to that of a financial portfolio manager, may be the best approach as it will facilitate implementation of commonality initiatives by tracking cost advantages at a global level, rather than distributed to programs.

ASSESSMENTS OF NAVAL VESSEL CONSTRUCTION EFFICIENCIES AND OF EFFECTIVENESS OF SPECIAL CONTRACTOR INCENTIVES

The Navy has implemented improvements for contractor furnished equipment/government furnished equipment (CFE/GFE), which are designed to eliminate duplicate inspection processes, reduce cycle times, and reduce rework. Similarly, in terms of design solutions, an Integrated Data Environment (IDE) is used as a repository for all ship drawings. This facilitates common designs, common parts, and configuration management. Production activities have also been targeted for cost reductions. A number of Lean/Six Sigma events were carried out to reduce the time and manpower needs for production tasks. These improvements allow more efficient construction and outfitting of the units prior to assembly.

In order to foster productivity changes, the Navy has utilized both performance specifications and contracting incentives. The Navy has moved away from standards to design specifications, which allow the contractor to meet requirements with increased "trade space", enabling continuous competition and exploitation of commercial techniques, materials, and designs. The second area of emphasis is contracting strategies. There are two main contracting incentive vehicles that the Navy has used recently to improve the infrastructure of the shipbuilders. The first is the specialized case related to Hurricane Katrina, in which the Navy has special authority to pay for infrastructure improvements in Gulf Coast Shipyards. The law provides not less that $140 Million for improvements to the Gulf Coast shipyards. While these funds were, in part, designated to expedite the repair of damaged facilities, they were also designated for improvements to the facilities which would result in future cost savings.

Since the Navy requires special regulatory relief to directly fund shipbuilding capitalization projects, contract incentives are more typically used as a means to motivate contractors to make improvements in processes and facilities. The Navy has recently implemented a number of different shipbuilding facilities investment incentives. For instance, the VIRGINIA Class Capital Expenditure (CAPEX) program is a 1.5 percent special incentive that is included in the VIRGINIA Class Block II multi-year ship construction contract. This program allows a portion of the overall contract profit to be diverted to fund a series of incentives. To earn the incentive, the shipbuilder has to show the cost/benefit analysis of the improvement. The Navy has up to $91 Million available to fund this program over the life of the contract (through 2008). At this time, the shipbuilder teams have identified $35.6 Million of projects, for a return of $320 Million in future cost avoidance.

Similarly, the DDG 51 Class program has implemented a CAPEX-type infrastructure improvement project called the "Ultra Hall". Using primarily contract withholdings and

incentives, Bath Iron Works (BIW) will build two outfitting bays and purchase additional equipment. This plan allows the shipbuilder to reduce staffing, reduce costs, improve quality, and enhance the modular construction of surface combatants as BIW is able to do a larger portion of the construction in a more modern covered facility. These savings will be realized on DDG 51 ships under construction, as well as future shipbuilding programs.

On the CVN 78 program, contracting incentives are used to motivate Northrop Grumman Newport News to meet cost targets. Coupled with incentives for technical performance in the design contract, the cost target incentive provides a balanced approach to cost, schedule, and performance control. As with CAPEX incentives, a fee recovery provision exists to recover a significant portion of the fee if the contractor deviates from previously provided cost estimates during construction contract proposal submission. In terms of capital improvements, the CVN 78 construction preparation contract incentivizes NGNN to make capital facility improvements in time to support CVN 78 ship construction.

CONCLUSION

The Navy has several efforts in progress designed to maintain a robust and modern shipbuilding industrial base. A key component of this effort is ensuring a stable demand signal from the Navy, so that the new construction shipyards can invest in modernization, knowing that there is a potential for return on investment.

The Navy is achieving cost reductions and efficiencies through commonality efforts. These efforts are composed of examining commonality at the system, ship, material, and process levels. In the long term, the Navy anticipates a substantial reduction in the procurement costs, test and evaluation, training costs, supply costs, and delivery schedules on future ship designs. The potential also exists to substantially reduce the number of hull types in the future Fleet.

To ensure the private shipyards are our partner in all of these modernization and cost reduction efforts, the Navy has implemented contract incentives. The CAPEX initiative, and other similar to it, demonstrates a successful means to motivate shipyard improvements. By modeling future contract incentives after CAPEX, the Navy can ensure the future of Navy shipbuilding is secure.

The Navy takes seriously the Subcommittee's desire that we examine shipyard modernization and contract incentives to increase efficiencies and reduce costs. The Navy will examine all of the factors discussed today when making future choices. We appreciate the opportunity to appear before the Subcommittee.

600 PENNSYLVANIA AVE., SE
SUITE 305
WASHINGTON, DC 20003
TEL 202.544.8370
FAX 202.544.8252
WWW.AMERICANSHIPBUILDING.COM

AMERICAN SHIPBUILDING ASSOCIATION

Statement of

Ms. Cynthia L. Brown

President

American Shipbuilding Association

Before the

House Armed Services Committee

Subcommittee on Seapower and Expeditionary Forces

March 20, 2007

Thank you, Mr. Chairman, Members of the Subcommittee, for holding this hearing on shipyard modernization initiatives and ship cost reductions.

The American Shipbuilding Association (ASA) is the national trade association of the six largest shipbuilders in the United States that build all of the capital ships for the U.S. Navy, and more than 70 companies that design and manufacture major ship systems and components. A membership list is attached.

Persistently low and unstable rates of naval ship production have taken a tremendous toll on the shipbuilding industrial base that is vital to our national defense. Since 2001, the Navy's fleet has plunged from 341 battle force ships to a 90 year low of just 276 ships today. Production rates of five capital ships a year, combined with ever changing program schedules and profiles, has presented U.S. shipyards with tremendous challenges in trying to manage workload to sustain our highly skilled engineering and production workforce, in having the ability to make investments in our facilities and processes, and in managing our day-to-day operations to ensure maximum efficiency in the design and construction of ships.

Put simply, there is no substitute for volume production in reducing the cost of every ship we build and in maximizing capital investments by our industry.

Even though we have struggled in an anemic production environment for many years, the shipyards have made and continue to make huge capital investments. Recent and on-going investments well exceed one billion dollars. These investments include the latest in automated design tools, covered facilities, an automated 4" steel cutting facility, facilities for constructing larger modules, cranes for increasing lift capability for larger modules, laser cutting equipment, state-of-the art panel lines, new and expanded power grids, and heavy moving equipment.

If asked, every shipbuilder would tell you that more capital investments in processes and facilities would increase efficiency and further reduce costs. Their ability to do so, however, depends on their cash flow, work projections, and profits to demonstrate a return on such

investments to their corporate parents. The current business environment for shipbuilding makes the corporate return on investment business case difficult to make given competing corporate interests and needs. Corporate investment dollars favor the facilities that have the largest profit margins and that show a growing order book.

Where shipyards may not be able to make the corporate return on investment business case, there are many investments that could be made in the shipyards that would show a very favorable return on investment to the Government. To make such investments possible, the American Shipbuilding Association asks you to consider legislation that would require the Navy to expand the use of "special incentive" fees in all Navy shipbuilding contracts for the purpose of investing in facilities and process improvements where the business case is made that the investment will result in a favorable return to the Navy.

The legislation we ask you to consider is a modified and expanded version of the current Capital Expenditure Program, or CAPEX, included in the *Virginia* Class Submarine contract. The CAPEX program provides for incentive fees to be awarded to the shipyards for the purpose of investing in facilities and process improvements if they make the case that such investments will result in savings in the program greater than the amount of the investment.

For example, an incentive fee award of $7 million to Newport News Shipbuilding to invest in a second Modular Outfitting Facility will result in an estimated savings of approximately $34 million in cost the *Virginia* Class Submarine Program. An investment of $9 million by Electric Boat in a new coating facility at its Quonset Point shipyard will save an estimated $140 million in the Program.

ASA recommends that the Navy include in all shipbuilding programs money for incentive fees for the purpose of capital investments if the contractor makes the business case that: 1) savings through changes in the design, material used, technology, or production process

would result in savings in the ship program, or; 2) a proposed investment itself would result in savings in a shipbuilding program or programs.

The proposed legislation recommends a fiscal year 2008 authorization and appropriation of $100 million as seed money for contract incentive fees. It would direct the Navy to report back to Congress no later than May 1, 2008, on how the Navy has distributed or plans to distribute the $100 million provided in FY08 for specific capital expenditures by shipbuilding program. It further provides that the Navy would budget annually money in all shipbuilding programs to provide incentive fees for the purpose of capital investment beginning in fiscal year 2009. Funding requested for incentive fees for this purpose would be required to be identified by the Navy by ship program concurrent with future budget submissions to the Congress.

This legislative proposal, which is attached to my statement, would reduce costs to the Navy by: 1) Emphasizing designs that translate into ships that are easier to produce; 2) Helping to control non-value requirement changes that add cost but are not operational necessities; 3) Reducing the costs of ship programs as a result of targeted investments, and; 4) Improving the competitiveness of shipyards in building both naval and commercial ships, which could in turn increase the number of ship orders in U.S. shipyards.

Withholdings and Retentions:

I would also like to bring to the Subcommittee's attention a Navy practice of withholding and retaining earned payments to the shipyards that hurt our efficiency.

Cash flow is vital to the day-to-day operations of the shipyards and to their ability to pay their subcontractors in a timely fashion. Today, there is more than $345 million being withheld or retained by the Navy in owed payments to the six shipyards as agreed to in their respective shipbuilding and overhaul contracts.

When shipyards do not receive payment on work performed in keeping with the schedule and terms of their contracts, their ability to operate efficiently can be significantly impaired. The

operations of major ship system and component manufacturers also suffer as payments to them are delayed. Should the shipyards be forced to borrow money to meet their financial day-to-day operating obligations, the interest costs associated with such loans are not billable to Navy contracts.

I urge the Subcommittee to consider legislation, which is attached, that would require the Navy to abide by the terms of its payment clauses and contracts as negotiated with each shipyard to ease a cash flow constraint that is unnecessarily being imposed on the industry. A question frequently asked is: "Why don't the shipyards go to court?" The policy and practice of most shipyards is to avoid if at all possible taking a dispute with the Navy to court since such action could halt work on ships and severely damage the working relationship with their predominant, if not only, customer. Action by the Congress, however, directing the Navy to abstain from this practice would solve the problem, or at a minimum, make the practice rare and significantly reduce the dollar value of payments withheld. Furthermore, it is in the Navy's own interest that the practice be stopped so that the shipyards have the cash flow to operate efficiently in building ships for the Navy.

Enforce U.S. Ship Acquisition Laws:

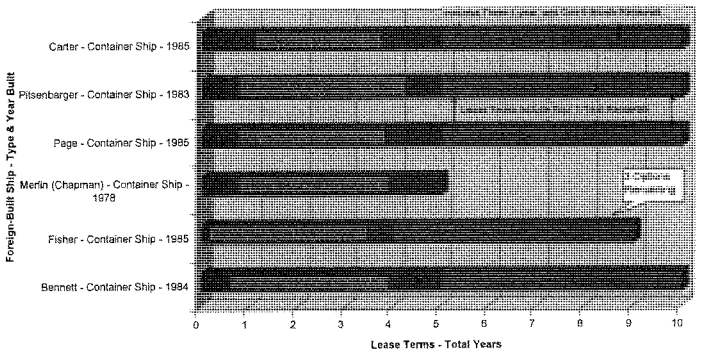
As stated earlier, there is no substitute for volume ship production in reducing the costs of ships.

Our industry does not propose that ships be budgeted or funded if there is no national defense requirement. However, when a long-term, dedicated military ship requirement exists, it should be filled by ships built in the United States in keeping with the letter and spirit of U.S. acquisition laws.

Ship production in the United States will not increase if DOD is allowed to meet its requirements by outsourcing shipbuilding to foreign shipyards by using long-term leases as a means to acquire foreign-built ships to meet dedicated military sealift and other missions.

As the chart below shows, there are six foreign-built ships that DOD is leasing for the purpose of prepositioning military equipment and ammunition. The terms of all of these leases is 59 months, including options. Five of the ships have had their 59 month leases renewed for an additional 59 months. This means that at the end of the contract period these ships will have been in continuous service to the military for two months shy of 10 years. Clearly, a long-term requirement exists for dedicated sealift ships. A long-term lease is a de facto purchase.

U.S. Dependence on Foreign-Built Ships



Source: American Shipbuilding Association; U.S. Navy Military Sealift Command

Section 7309 of Title 10 U.S. Code states that a vessel purchased for all branches of the Armed Forces shall be built in the United States. The Budget Enforcement Act of 1990 resulted in regulations defining a vessel lease of five years or more as a purchase.

Because these leases are one month shy of five years, they are not ruled as purchases in violation of the Budget Enforcement Act or U.S. acquisition laws. However, the practice of having a foreign-built ship under continuous service to the Department of Defense for almost ten years should by the definition of government regulations be classified as a purchase.

If DOD is permitted to outsource a portion of its dedicated military fleet to foreign shipyards, the cost of the ships DOD does buy from U.S. shipyards will increase as volume in the shipyards and throughout the defense manufacturing base is reduced.

My industry commends Chairman Gene Taylor and Congresswoman Jo Ann Davis for sponsoring legislation to limit the lease terms of foreign-built ships to a period of no longer than two years. This legislation would grandfather the foreign ships that have already been converted from commercial ships to military auxiliary ships that are presently being used by DOD. It would, however, going forward remove the economic incentive of a foreign ship owner to invest in the conversion of a used, commercial ship to a military ship in the absence of an assured 59-month lease to recover that investment.

Congress established the National Defense Sealift Fund in 1990 for the express purpose of providing a fund where all services could budget for the construction of ships in the United States to meet their dedicated strategic sealift needs.

ASA urges Congress to include the Taylor/Davis legislation in the fiscal year 2008 National Defense Authorization Act, and asks that this Subcommittee encourage DOD to budget in the National Defense Sealift Fund in its fiscal year 2009 budget submission to Congress funds for the construction of the ships it needs for strategic sealift.

Thank you for your consideration of these recommendations to strengthen the shipbuilding industry.

600 PENNSYLVANIA AVE. SE
SUITE 305
WASHINGTON, DC 20003
TEL 202.544.8170
FAX 202.544.8252
WWW.AMERICANSHIPBUILDING.COM

AMERICAN SHIPBUILDING ASSOCIATION

Membership of the American Shipbuilding Association

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Deer Park, NY

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American Iron & Steel Institute
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DRS Technologies
Parsippany, NJ

Earl Industries, LLC
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Erie, PA

Electric Power Technologies, Inc., DRS
Hudson, MA

Electronic Systems Inc., DRS
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EMS Development Corporation
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G. E. Marine
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San Diego, CA
Tupelo, MS

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Guill Tool & Engineering Co., Inc.
West Warwick, RI

Henschel
Newburyport, MA

Hose-McCann Telephone Co.
Deerfield Beach, FL

IMECO, Inc.
Iron Mountain, MI

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L3 Communications
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Marlo Coil
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Montville, NJ

Motion Industries, Inc.
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ODI Advanced Technology Systems
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Pacific Consolidated Industries
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Danbury, CT
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Power Paragon
Anaheim, CA

Power Technology Inc.
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Rolls-Royce Naval Marine
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San Diego, CA

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Training & Control Systems, Inc., DRS
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Wartsila Lips, Inc.
Chesapeake, VA

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Tulsa, OK

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York, PA

NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2008
DIVISION A—DEPARTMENT OF DEFENSE AUTHORIZATIONS
TITLE I—PROCUREMENT
SUBTITLE C—NAVY PROGRAMS
SEC. 12X. CAPITAL EXPENDITURE INCENTIVES IN NAVY VESSEL CONSTRUCTION CONTRACTS FOR ALL CLASSES OF SHIPS AND SUBMARINES.

(a) DIRECTIVE TO INCLUDE CONTRACTUAL INCENTIVES.—The Secretary of the Navy shall provide and budget for capital expenditure incentives to support investment in shipyard facilities and process improvements in current and future Navy vessel construction contracts under a vessel program, for all classes of ships and submarines, where the Secretary approves a fully supported business case analysis submitted to the Navy by a contracting shipyard for—

(1) a proposal intended to create savings in vessel program construction costs through alterations in the design, material, technology, or manufacturing process of the vessel program being contracted for construction; or

(2) a proposal intended to create savings in vessel program construction costs as a result of investment in shipyard facilities and process improvements.

(b) CONSIDERATION AND APPROVAL OF SUBMITTED PROPOSALS.—Pursuant to paragraph (a), the Secretary shall take into consideration any such business case analysis and proposal demonstrating a projection of favorable return on investment to the Navy. The Secretary shall then provide the contracting shipyard a full, fair, and good faith written evaluation of any such business case analysis and proposal not later than 60 days after the date of submission, and shall base approval of any such proposal upon determination by the Secretary that the proposal is sound and therefore in the best interests of the vessel program under the contract.

(c) PROHIBITION AGAINST CIRCUMVENTING INCENTIVES.—The Secretary shall not allow circumvention of contractual capital expenditure incentives through change orders or any other contractual instrument, device, or exercise of any option seeking benefit for the Navy from any element of a proposal submitted by a contracting shipyard under this section that is not approved by the Secretary, nor shall the Secretary disapprove of a proposal solely on the basis that a related project was initiated prior to the proposal's submission.

(d) AUTHORIZATION OF APPROPRIATIONS.—Funds are hereby authorized to be appropriated for fiscal year 2008 for capital expenditure incentives to support investment in shipyard facilities and process improvements in Navy vessel construction contracts for all classes of ships and submarines in the amount of $100,000,000.

(e) REPORTING REQUIREMENT.—Not later than May 1, 2008, the Secretary shall submit to the Committees on Armed Services of the Senate and the House of Representatives a report on the amounts that have been and that are planned to be contractually allocated by the Navy to fund capital expenditure incentives, as authorized to be appropriated by paragraph (d) and pursuant to paragraph (a).

(f) ANNUAL BUDGETING REQUIREMENT.—The Secretary shall submit as part of the Navy's overall budget request to the Committees on Armed Services of the Senate and the House of Representatives the amounts specifically requested by the Navy

for each Navy vessel program pursuant to paragraph (a) for fiscal year 2009 and annually thereafter.

(g) IMPLEMENTING REGULATIONS.—The Secretary shall promulgate any regulations necessary to implement this section not later than 180 days after the date of the enactment of this Act.

NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2008
DIVISION A—DEPARTMENT OF DEFENSE AUTHORIZATIONS
TITLE I—PROCUREMENT
SUBTITLE C—NAVY PROGRAMS
SEC. 12X. WITHHOLDINGS AND RETENTIONS.

(a) DEFINITIONS.—For purposes of this section, a "withholding", as it relates to a payment based upon percentage of completion of construction or overhaul of a Navy vessel, is defined as any difference between the actual amount approved for payment and the amount determined by multiplying one hundred percent of the allocated total contract price for such vessel by the percentage of physical progress or completion of the vessel. Also for purposes of this section, a "retention" is defined as any amount less than one hundred percent of the allocated total contract price of a Navy vessel that is not paid by the Navy to a shipyard for the construction or overhaul of such vessel after delivery of the vessel to the Navy.

(b) PROHIBITION AGAINST WITHHOLDINGS.—The Secretary of the Navy shall not allow any withholding, nor the placement of any conditional requirement by the Navy on the release of any earned payment based upon percentage of completion of construction or overhaul of a Navy vessel.

(c) LIMITATION ON RETENTIONS.—The Secretary shall not allow any retention beyond the lesser of the expiration of a contractual guaranty period or one year after the vessel is delivered to the Navy, nor the placement of any conditional requirement by the Navy on the release of any retention.

(d) PROHIBITION AGAINST COMPENSATORY ADJUSTMENTS.—Neither the rates of payments based upon percentage of completion of construction or overhaul, nor guaranty retentions shall be affected by the timely release of withholdings and retentions resulting from the enactment of this Act.

(e) REPORTING REQUIREMENT.—Upon the enactment of this Act and then again upon the passage of every six-month period thereafter, the Secretary shall submit to the Committees on Armed Services of the Senate and the House of Representatives a report describing the precise amounts of current Navy withholdings and retentions in the construction and overhaul of Navy vessels.

(f) IMPLEMENTING REGULATIONS.—The Secretary of Defense shall promulgate any regulations needed to implement this section not later than 180 days after the date of the enactment of this Act.

NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2008
TITLE ____ GENERAL PROVISIONS
SUBTITLE ____ POLICY RELATING TO SHIPYARDS AND VESSELS
Sec. _____ . LIMITATION ON LEASING OF FOREIGN-BUILT VESSELS
(a) IN GENERAL –
(1) Chapter 141 of title 10, United States Code, is amended by inserting after section 2401a the following new section:

'Sec. 2401b. Limitation on lease of foreign-built vessels

(a) LIMITATION – The Secretary of a military department may not make a contract for a lease or charter of a vessel for a term of more than 24 months (including all options to renew or extend the contract) if the hull or a component of the hull, or superstructure of the vessel is constructed in a foreign shipyard.

(b) PRESIDENTIAL WAIVER FOR NATIONAL SECURITY INTEREST –
(1) The President my authorize exceptions to the limitation in subsection (a) when the President determines that it is in the national security interest of the United States to do so.

(2) The President shall transmit notice to Congress of any such determination, and no contract may be made pursuant to the exception authorized until the end of the 30-day period beginning on the date on which the notice of the determination is received by Congress.'

(2) The table of sections at the beginning of such chapter is amended by inserting after the item relating to section 2401a the following new item:
'2401b. Limitation on lease of foreign-built vessels.'

(b) EFFECTIVE DATE – Section 2401b of title 10, United States Code, as added by subsection (a), shall apply with respect to contracts entered into after the date of the enactment of this Act.

STATEMENT FOR THE RECORD

Mr. Philip A. Teel
Corporate Vice President, Northrop Grumman Corporation and
President, Northrop Grumman Ship Systems, Inc.
1000 Jerry St Pe` Highway
Pascagoula, Mississippi 39568
Telephone: (228) 935-7447

Testimony Before The
House Armed Services Committee
Subcommittee on Seapower and Expeditionary Forces

Tuesday, March 20, 2007
2:00 pm
2212 Rayburn House Office Building Committee Room

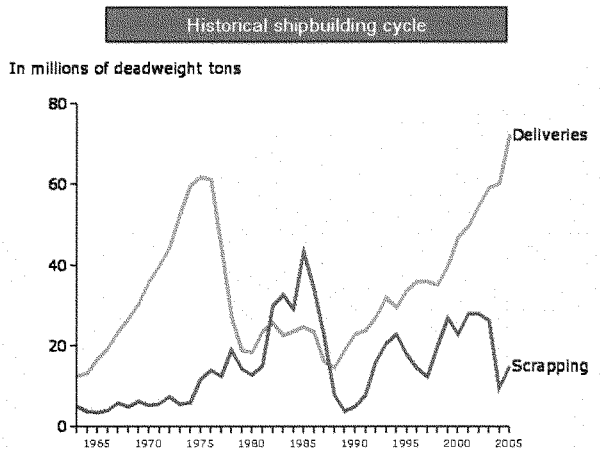
Chairman Taylor, ranking member Bartlett, distinguished members of the subcommittee, thank you for the opportunity to appear before you today to discuss the state of the U.S. shipbuilding industry and what may be done to modernize the industry. Today I represent the entire shipbuilding segment of Northrop Grumman Corporation, which is Newport News and Ships Systems.

Before beginning a specific discussion about modernization, it is important to make clear the objective of such a discussion. We believe the objective is to build ships with the capabilities that meet the Navy's and Coast Guard's needs at lower cost than today. That being said, we must recognize that facility modernization alone will not achieve that objective. Such modernization must occur in combination with (or even after) process changes (whether they be internal to the shipbuilder or between the shipbuilder and its key customers) in order to realize true benefit for the Navy, Coast Guard, industry participants, and most importantly, the U.S. taxpayers.

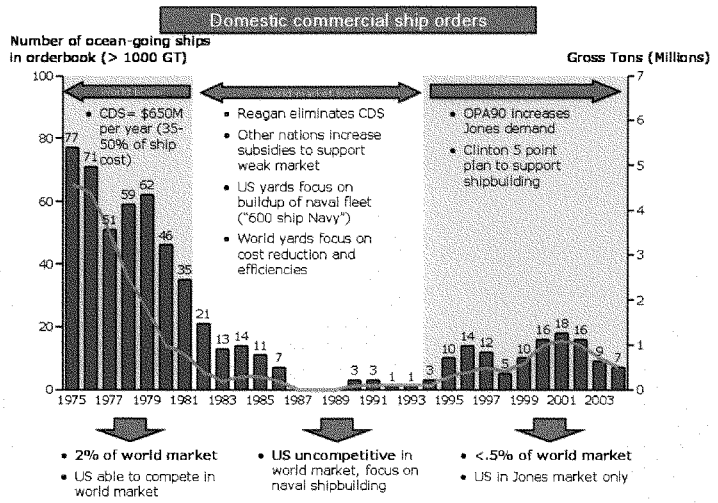
It is important when assessing the state of shipbuilding in this country, and what can be done to modernize, to understand how we arrived at our current state. Since the 1970s, U.S. military shipbuilding, U.S. commercial shipbuilding, and global commercial shipbuilding have each taken distinctly different paths. In 1969, in response to the U.S. Navy's plan to build a new class of destroyers and large deck amphibious ships, then Litton Ingalls Shipbuilding Company embarked on an ambitious plan to develop a completely new production process. The result was a production facility designed to support the revolutionary modular build approach to shipbuilding. At the time, modular production was cutting edge and was quickly adopted by both military and commercial shipbuilders worldwide. Since the introduction of modular building more than 30 years ago, the focus of U.S. military shipbuilding has shifted away from production process improvements toward advanced weapons and ship technologies and a capability to integrate these capabilities onto naval vessels. As a result, the U.S military has the most technologically advanced ships in the world, a fact that comes with a fundamental cost to the nation in order to maintain the dominance of our naval forces. At the same time, the U.S. military shipbuilding process and associated facilities have significant room for improvement when compared to best-in-class commercial shipbuilders who have primarily focused on production process improvements and cost reduction since the early 1970s.

U.S. commercial shipbuilding peaked in the mid 1970s along with a spike in the cyclical global shipbuilding market. Historically, the cyclicality of shipbuilding demand has been primarily driven by significant swings in replacement demand, which tend to peak at about 30-year intervals. This occurred in the mid 1970s with a volume of over 60 million deadweight tons being delivered in the form of new ships in 1975. Global ship production did not reach that level of output again until 2004. During the mid-1970s boom, the U.S. federal government subsidized up to 50% of the construction cost of commercial ships built in the U.S. under the Construction Differential Subsidy program.

The subsidy was paid to the U.S.-flag ship owner rather than the shipbuilder and was only available for those ships built in the United States that were registered under the laws of the U.S. and operated in international trade. This program supported production of commercial ships in U.S. yards despite the disparity in costs of production between those yards and foreign shipyards.

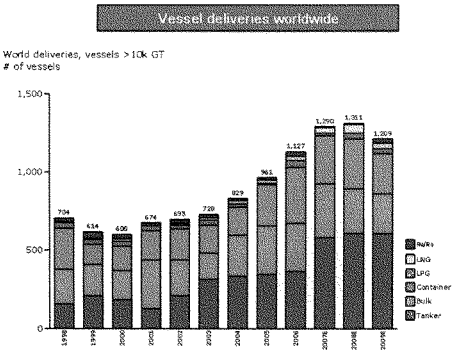


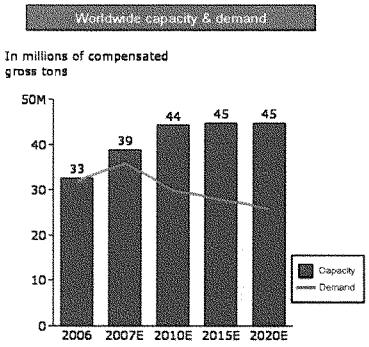
This subsidy along with the Jones Act, also known as the Merchant Marine Act of 1920, helped sustain commercial shipbuilding in the United States through the 1970s. However, two events in the early 1980s dramatically changed the path of commercial shipbuilding in the U.S. First, the global market for commercial vessels, which was supply constrained in the 1970s, experienced a significant downturn in demand. Second, at the same time demand was declining, in 1981 the Construction Differential Subsidy was terminated. As a result, commercial shipbuilding activity dropped dramatically, and investment in domestic shipyards similarly declined. Today, U.S. commercial shipbuilders are not competitive in the global market, with costs that are two to three times higher than international low cost producers. This is highlighted by the fact that in 1979 the U.S. share of world commercial tonnage was 9%; by 2006 the U.S. market share was less than 1%.



While U.S. commercial shipbuilding has been in decline, global shipbuilding has grown significantly. During the down cycle that followed the boom of the mid-1970s, the commercial shipbuilders that survived focused heavily on all aspects of cost reduction. Successful players in this market leveraged natural advantages, such as lower labor costs, and artificial advantages, such as government support, to create initial leadership positions. As the market began its current up-cycle in the mid to late 1990s, commercial shipbuilders have further reduced costs and increased efficiencies by focusing on standardization and mass production. For example, in 2006 Hyundai Heavy Industries delivered 49 container ships and China State Shipbuilding Corporation delivered 37 bulk cargo ships. In contrast, all U.S. yards delivered a total of 7 Jones Act ships in 2006.

Today, the worldwide commercial shipbuilding market is booming again. The number of vessels being delivered globally each year has been growing at greater than 6% per year and topped the 1000 mark for the first time in 2006. The growth in this $75 billion market has been driven by a combination of increased demand for shipping capacity and very strong ship replacement dynamics. In fact, the "replacement cycle" dynamics appear to be very similar to the dynamics experienced in the mid-1970s, when replacement volume previously hit a peak. Forecasts for future global shipbuilding demand vary, but several analysts expect some of the replacement demand to enter another down-cycle and thus the overall demand to level off or even decline. Nevertheless, the rapid growth of the commercial market has resulted in significant additional investment and expansion from major shipbuilding countries, who continue to increase their shipbuilding capacity and capabilities.



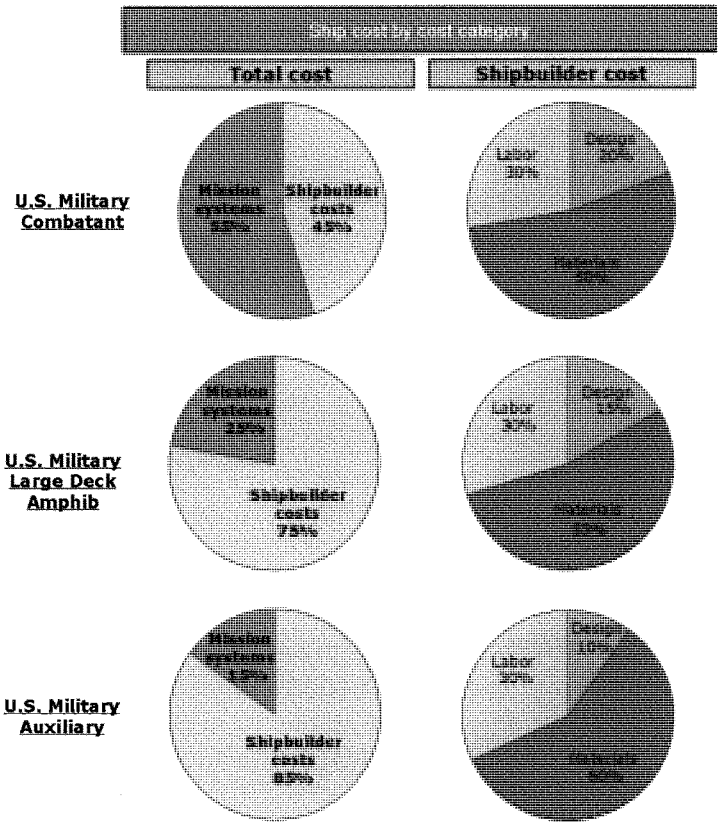


When considering modernization for the U.S. shipbuilding industry, it is thus instructive to look at these best-in-class shipyards across the globe. Several of you, as well as many leaders from my organization, have visited a number of these production facilities. What we have learned is that best practice commercial shipbuilding is characterized by an intense focus on design for production, which includes elements such as standard designs, the use of proven systems and subsystems, standard parts and components, limited customization, minimal to no change vessel to vessel, and large production runs. All of which facilitate an efficient and affordable production process.

In contrast, U.S. naval shipbuilding, which represents over 90% of annual U.S. shipbuilding production in terms of value, is a very different business model. Naval shipbuilding is characterized by complex, continuously evolving designs, advanced technology systems, many changes and small production runs. These characteristics necessitate a flexible, custom shop production process that can meet military requirements that vary widely by ship type, from program to program, and sometimes by hulls within a given program.

Within a surface combatant ship, 55% of the total ship cost is comprised of combat systems that are procured directly from the original equipment manufacturers by the U.S. Navy and provided to the shipbuilders. These combat systems are a critical enabler behind our warships being able to fulfill the mission requirements of the U.S. Navy and Coast Guard, and the investments in these systems have resulted in significant weapon systems advancements. These systems can also impact shipbuilder costs by introducing additional complexity (e.g., systems integration) into the production process. In fact, they could, in some instances, work against each other. Consider a hypothetical example, where radar system advancements result in the addition of equipment to the ship. This could result in the redesign of a set of compartments on the ship, which increases the cost of ship production and in turn limits the learning curve benefits associated with repeatedly producing the same ship design.

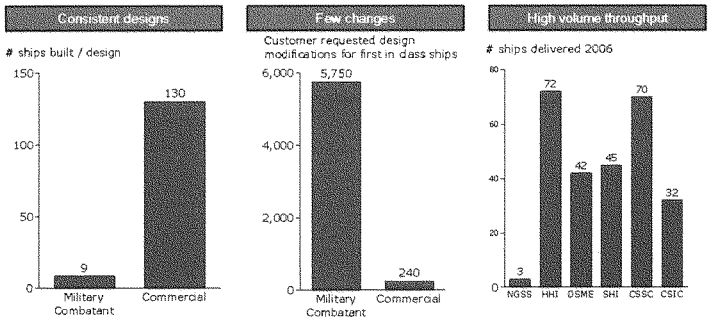
We must recognize that advancements in the combat systems and mission systems of the ship do impact the real costs associated with ship production as well as total ship costs. As a result, while the shipyards should and are taking action to address their shipbuilding cost structures, those efforts will impact only approximately 50% of the total cost of the ship for a surface combatant, approximately 75% for a large deck amphibious ship, and 85% for an auxiliary vessel; and the improvements could be offset by the effects of mission system design changes.

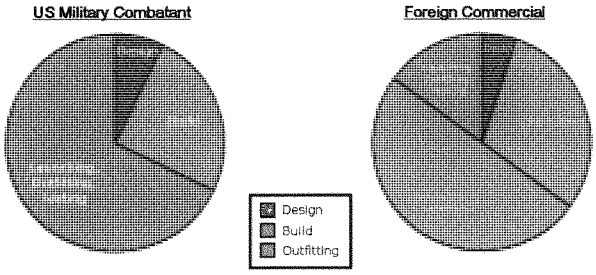


To illustrate the differences between best-in-class commercial and U.S. military shipbuilding consider the following examples:

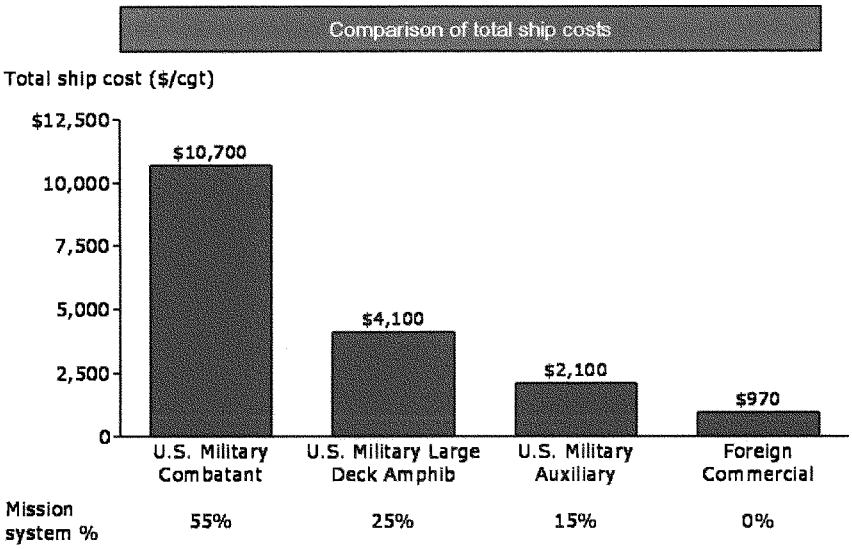
- Best-in-class commercial ship programs average 240 changes per first-in-class ship and just 2 per follow-on ship, while the U.S. Navy LHD program had about 5,750 changes from LHD 1 to LHD 2 and an average of about 3,550 additional changes for each follow-on ship.

- The split of value chain activities differs significantly between military and commercial shipbuilding. Steel cutting, pre-outfitting and assembly make up about 70% of activity for a commercial ship, but only about 20% of activity for a surface combatant. Furthermore, integration and testing represents only about 15% of commercial shipbuilding's value stream, but 70% of the value stream for a surface combatant.
- Commercial shipbuilders tend to have much larger runs of standard designs. Commercial shipbuilders average over 130 ships produced per design while the average for U.S. military programs is just 9.





All of these differences result in a very different cost structure between military and commercial programs. On an equivalent ton basis, best-in-class commercial ships cost about $970 per ton. In contrast the cost per ton for military combatants is $10,700, for large deck amphibious ships is $4,100, and for auxiliary ships is $2,100.

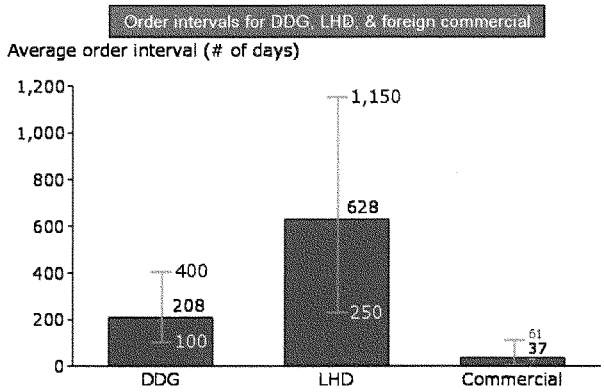


While separate and distinct businesses, some techniques developed in best-in-class commercial yards can be applied to military ship production. These techniques, including the production of more hulls for each given design (run lengths), better managed time gaps between ships (order intervals), and reduction of change within and between ships, represent opportunities to reduce the costs of U.S. Navy and Coast Guard ships.

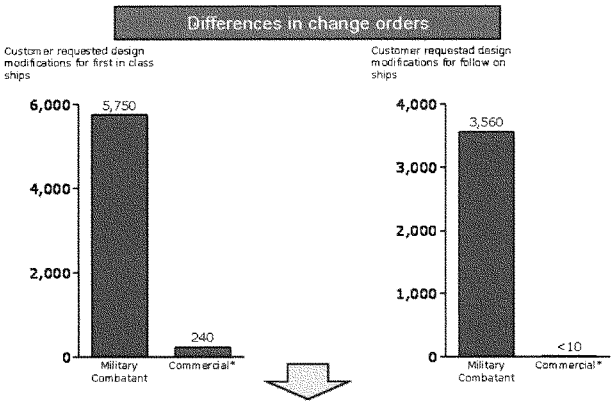
Additionally, and perhaps more importantly, a much greater collective focus on design for production would identify opportunities to reduce the complexity that currently exists in military ships. This complexity reduction could take many forms – common hull designs, standardization of units or modules within ships, designs that contain much less curvature, etc. But they are all driven by the notion of designing ships with the production of the ship in mind, so that total production costs can be reduced while not sacrificing the ship's mission. This notion dominates the global commercial market; it does not define the U.S. military market. In fact, near-term budgetary concerns often disincentivize relatively modest upfront alternative design analyses even if such analyses were expected to substantially reduce production costs in the out years.

The length of production runs and order intervals represent significant opportunities. Even on military programs characterized by relatively long production runs (by military ship standards), the interval between orders is rarely standard and can be a key driver in increased costs. The order rate for DDG 51 class ships has varied from a high of five ships per year to a low of two. Lengthy breaks in production can completely eliminate learning curve efficiencies, driving up labor costs that represent ~30% of the shipbuilder's portion of the cost of a ship. We estimate that the changing production

interval on DDG 51 class ships produced by NGSS has added as much as 15 million labor hours and $430 million to the overall cost of the program. Additional cost savings from longer production runs and managed production intervals can also be found in lower material costs that represent ~50-60% of the shipbuilder's portion of the cost of a ship, as suppliers would be able to come down their experience curves at a greater rate and shipbuilders would be able to buy materials in higher quantities. Best-in-class commercial programs maintain short intervals between ships that result in steep learning curves due to continuous experience gain. High steady rate serial production of standard designs in combination with a focus on design for production also permits commercial shipbuilders to automate many production processes.



Change orders represent another area of opportunity to learn from best-in-class commercial shipbuilders. We estimate that change order activity on NGSS built Arliegh Burke destroyers have added as much as 6 million labor hours to production at a cost of $160 million. In addition to experience loss, change orders impact shipbuilders' design costs (incremental design requirements, change/configuration management costs), labor costs (schedule disruption, rework labor) and material costs (replacement material). The elimination of such changes could dramatically reduce ship production costs, but must be considered in light of the need to deliver the most advanced technological solution to the warfighter. Strong systems engineering skills among the U.S. Navy, U.S. Coast Guard, and shipbuilder teams are necessary to balance these valid, yet competing, demands.



As mentioned previously, design for production is the norm in commercial ships, but not in military ships. Even given the need for battle hardening in military ships we find little commonality of design for key systems across different classes of ships. This drives complexity in the manufacturing process both at the shipyard and amongst vendors. This lack of commonality drives up the labor portion of the shipbuilder's costs by eroding the remainder of the learning experience in our production work force due to the lack of repetitive processes.

Additionally, design and production processes vary from program to program. For example, design tools vary from program to program despite the investment made by the government in some cases to develop those tools, resulting in higher design costs. This adversely impacts the shipbuilder's ability to specialize, to automate and to develop a specialized vendor base. Best-in-class commercial yards are able to focus on standardizing key production activities, automating those activities and thus leveraging the learning curve.

Thus, in summarizing the comparisons of our U.S. Navy and Coast Guard shipbuilding model to the best-in-class commercial shipbuilders, the models and results from a cost standpoint are quite different. The question then for all of us (shipbuilders, weapons systems providers, and U.S. Navy, Coast Guard and Congress) becomes how much learning from the global commercial shipbuilding business can we apply to our U.S. military shipbuilding business? We believe there are meaningful lessons to be learned with two very important observations:

1. Most of the opportunities begin with process changes that can be enabled by supporting equipment or facilities.
2. Under the current ship procurement model, no single party can drive these improvements alone. A collective effort is required to get all elements of these potential process changes aligned.

With those observations in mind, it is important to recap the key lessons learned from the analysis of global commercial shipbuilding:

1. Commercial shipbuilders have an intense focus on design for production, which results in more cost effective designs and reduced complexity throughout the shipbuilding system.
2. Most commercial shipbuilders produce a much greater number of ships for a given design and are able to maintain tighter timing between the production of sequential ships.
3. Commercial shipbuilding has much fewer changes that occur to the design of the ship, both during production and between ships in a class.

The result of these and other differences is a significant cost differential between best-in-class commercial production and the production of U.S. Navy and Coast Guard ships. We do not presume that we can close this entire cost gap, as the nature of the mission requirements of military ships is much different than that of commercial ships. However, we do believe that several elements of the lessons learned from best-in-class commercial shipbuilding can be employed to decrease the costs of military ship production in the U.S.

We, the shipbuilders, can independently address some of these opportunities. Northrop Grumman has proceeded down this path. We engaged the same experts that completed the Department of Defense shipbuilding benchmarking study to help us identify what we must do to achieve best-in-class standards for our facilities, processes and for our work force. We are improving our design for production capability, acquiring a new, more flexible, proven production planning tool, investing in facilities improvements and new equipment, increasing our focus on process improvement and investing in better training for our work force. We will continue down this path with the goal of producing more affordable ships for the U.S. Navy, Coast Guard, and American taxpayer.

However, it is our belief that a much greater amount of cost reduction can be achieved if the U.S. Navy, the Coast Guard, Congress, and the shipbuilding community work together to attack these critical issues. Clearly most of the lessons learned cross organizational boundaries. Design for production must balance mission requirements, ship design standards (NVR, ABS) and shipbuilder facility, equipment and process capabilities (both current and planned). Production runs and order intervals are influenced by Navy and Coast Guard strategy, Congressional funding, and shipbuilder performance. Design changes are driven by maturing technologies in both the shipbuilding and mission systems arenas, evolving Navy and Coast Guard requirements, and changes in the production process. We believe that if these groups work together to address the opportunities, the result will be more affordable ships for the American taxpayer.

For example, working together we could modify our design requirements and processes to significantly increase the amount of off the shelf material that is acceptable on military ships. We could jointly develop "quick connects" to join electrical or pipe runs through the ship that both meet acceptable survivability and reliability requirements of the Navy

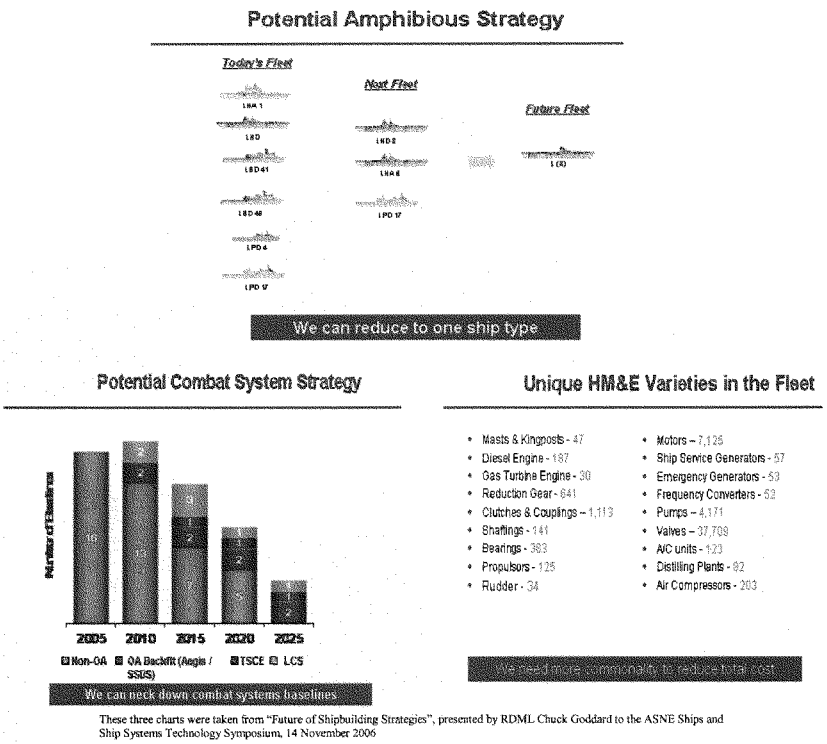
and Coast Guard and are much less costly to produce. We could develop a roadmap to achieve a standard ship design process on one design tool to provide greater standardization across platforms. Finally, we could jointly invest in the development of a stronger vendor base, through more standard requirements, smoother production cycles, and possibly capital investment.

We expect that some of these solutions will require capital investment. As mentioned previously, most of these capital investments should follow process changes and solutions; it is our view that investing this capital now without addressing the issues identified above would not be the most prudent use of the taxpayer's dollar. When it comes time to pursue such investments, we believe that the American Shipbuilding Association's proposed CAPEX legislation would provide one effective vehicle to fund improvements in production efficiencies while providing the U.S. Navy, Coast Guard, and Congress the ability to measure the true value of those improvements in program specific terms.

Examples of potential investments that could be consistent with a design for production path and potentially be funded through the American Shipbuilding Association's CAPEX legislation include:

1. Technology upgrades to shipbuilders' pre-production processes (impacts shipbuilder's design, labor and material costs)
2. Investment in heavy machinery assembly and grand block assembly buildings which would enable the creation, and more importantly, testing of much larger grand blocks in the production process (impacts shipbuilder's labor costs)
3. Investment in thin panel technology and equipment that could significantly reduce the amount of heat straightening that currently needs to be performed on thin panels (impacts shipbuilder's material and labor costs).

Furthermore, we applaud the Chief of Naval Operations, Commander Naval Sea Systems Command and PEO Ships for their interest in common hull designs, common mission systems and common HM&E equipment which we believe will promote larger production runs, reduced complexity and more affordable ships. Standardization can also extend past just the concept of common hulls. At a micro level, we can work better together to standardize parts, systems and geographical elements (e.g., masts, compartments) within a hull. We also could use some of those standard elements across different hull designs. Additionally, we could expand the standardization of functional modules to encompass much more of the system components of the ship (something on which we have made substantial progress working with General Dynamics on the DDG 1000 design).



These three charts were taken from "Future of Shipbuilding Strategies", presented by RDML Chuck Goddard to the ASNE Ships and Ship Systems Technology Symposium, 14 November 2006

Together, we can also address the issue of production intervals. The Navy should request and Congress should authorize more multi-year contracts and block buys. Shipbuilders should then do their part by making investments to ensure that associated learning curve labor savings and material cost reductions are realized. The U.S. Navy, Coast Guard, Congress and industry should also review the current CNO's 313-ship plan to see if something could be done to address production intervals. All parties can work together to develop change order management approaches that both significantly reduce the number of changes that occur during a ship's production and between ships, and provide a better way to manage the impact of changes that do need to occur.

To pursue these opportunities and more, we recommend that this committee authorize a joint study to analyze and provide specific process and capital investment recommendations to reduce the cost of U.S. Navy and Coast Guard ships. This initiative should, at a minimum, have representation from the major shipbuilders, the major mission system and propulsion system developers, the Navy, and the Coast Guard. Such a study should certainly evaluate the opportunities we have highlighted in this statement, but also include the evaluation of substantial ideas from other industry participants, the

Navy and the Coast Guard. Northrop Grumman would be thrilled to be an active leader of such an initiative.

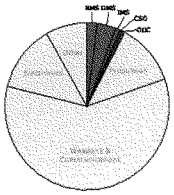
In summary, we believe the modernization of the shipbuilding industrial base will require the collaboration and commitment of private industry, the Department of Defense, Coast Guard and Congress. Our analysis shows a number of areas in processes, facilities, and technology where changes can yield significant improvements. We at Northrop Grumman have embarked upon and are committed to a comprehensive effort to change those things we can. We stand ready to work with the U.S. Navy, the Coast Guard, and Congress to facilitate as we are able those things that are the purview of the Government.

Thank you again for the opportunity to appear before you today to discuss this subject of vital importance to our national security.

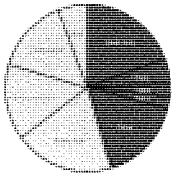
Appendix:

Differences in ship materials

US Military Combatant



Foreign Commercial



PRELIMINARY

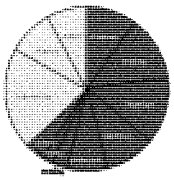
- Equipment & Systems
- Commodities

- **Quality requirements**
  - Military:
    - MILSPEC, must undergo rigid testing for function, interaction & reliability
    - Greater SKU complexity, 10x number of pipe part types vs. commercial
  - Commercial:
    - Testing for basic functionality
- **Customization**
  - Military: High degree of customization
    - Requires special production & vendor involvement
    - Few substitution options
  - Commercial: Little to no customization
    - Almost always use OTS material
      - Readily available with many substitution options

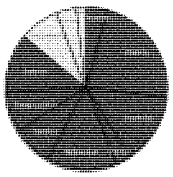
Material on Military ships is more costly due to quality & customization requirements

Differences in labor requirements

US Military Combatant



Foreign Commercial



- White-collar
- Blue-collar

	Military	Commercial
Total labor requirements	4M hrs	0.5M hrs
Focus of labor	Hull, Auxiliary, Electrical Systems	Hull
White- to blue-collar workers	1:2	1:6
% of Electricians*	16%	1%
Blue-collar supervisors to workers	1:6	1:20

Drastic work force differences between commercial and military

-Military: Large number of white-collars & supervisors result in much higher overhead costs

-Commercial: Small number of white-collars & supervisors restrict ability to handle military requirements

Michael W. Toner

Executive Vice President – Marine Systems

General Dynamics Corporation

Testimony before the

House Armed Services Committee

Seapower and Expeditionary Forces Subcommittee

Washington, D.C.

March 20, 2007

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Michael W. Toner

Executive Vice President – Marine Systems

General Dynamics

Michael W. Toner became an executive vice president of General Dynamics in March 2003. He is responsible for the Marine Systems group, which includes Bath Iron Works, Electric Boat and NASSCO. He had been a vice president of General Dynamics since January 2000 and president of Electric Boat from January 2000 to October 2003.

Toner joined Electric Boat in 1965 as a test engineer and over the next 25 years had held several managerial positions, including manager of Reactor Services, manager of Trident ship's management, assistant general superintendent of the Pipe Shop, and director of facilities management. In 1990, Toner was appointed Electric Boat's director of operations and directed all production, planning and support activities from the start of a submarine's construction to its delivery. He was promoted to vice president of operations two years later. In 1994, he was appointed vice president of delivery and was responsible for all production, delivery and support activities at Electric Boat's five facilities in Connecticut, New Jersey, New York and Rhode Island. In 1995, he became vice president of innovation and was responsible for all engineering and design activity. In 1998, he became senior vice president of Electric Boat.

Toner was born in April 1943, in New Brunswick, New Jersey. He earned a bachelor's degree in nuclear science from the New York Maritime College in 1965, a master's degree in engineering from the University of Connecticut in 1970, and an executive-level master's degree in business administration from the University of New Haven in 1982.

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Opening Remarks

Mr. Chairman and members of the committee, I am Mike Toner, Executive Vice President of General Dynamics Corporation Marine Systems. Thank you for convening this hearing. Two years ago I spoke in a similar forum to the Senate Armed Services Committee Seapower Subcommittee on the status of General Dynamics' shipyards and the future outlook for the shipbuilding industry. At that time I noted several critical steps that were essential to reducing the cost of ships. Paramount among these steps was ensuring a stable shipbuilding plan. As reflected in the Navy's FY08 Long Range Shipbuilding Plan, submitted to Congress last month, it appears that this goal has been partially achieved - there are no changes to the Navy's force structure requirements.

Unfortunately, what we are beginning to see in the Navy's FY08 funding plan is a downward trend in funding from the FY07 plan. Specifically, the FY08 plan shows a reduction in New Construction funding of nearly $3.5B from the FY07 plan over the four year period FY08 – FY11, with a $900M reduction in FY08. The risks in failing to meet the Navy's funding requirements are clear – the continued erosion of the shipbuilding industrial base and greater risk to achieving stated force level goals. This trend is particularly an issue in that the Navy's FY08 Long Range Plan also states that the "annual funding required to achieve and sustain the 313 ship force structure is about $13.4B (FY05) per year or $14.4B (FY07) per year."

It is significant to note that although overall defense spending has returned to or surpassed Cold War levels, the shipbuilding component of the defense budget is only about three-quarters of what was funded over the 1980's. Compounding this issue is the recovery from the 1990's when shipbuilding funding declined to about 50 percent of Cold War levels. Across the industry, these dramatic market changes have had severe implications to employment, economic viability, and certainly in the ability to invest in facilities and process improvement.

A commitment to program and funding stability is absolutely essential to provide both shipbuilders and suppliers with the confidence to make the investments that will improve our efficiency, modernize the industrial infrastructure, and develop processes and technologies equal to world class standards.

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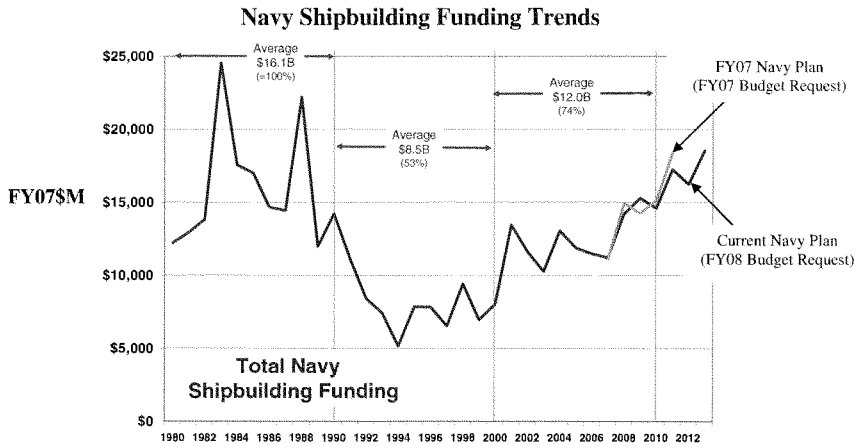
Just as important as program and funding stability is increased volume. With increased volume, industry will achieve greater labor efficiency, reduced labor rates through increased overhead absorption, and reduced material costs through more economic quantity purchases. Most importantly, we will continue to deliver the highest quality warships to the Navy at a more affordable cost.



The risks in failing to meet the Navy's funding requirements are clear – the continued erosion of the shipbuilding industrial base and greater risk to achieving stated force level goals.

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General Dynamics Marine

General Dynamics Marine is comprised of three major shipyards: Bath Iron Works in Bath, Maine; Electric Boat is Groton, Connecticut; and NASSCO in San Diego, California. These shipyards have a long and proud history of providing the Navy with ships and submarines used to project U.S. presence around the globe The Marine Group offers a broad range of integration, design, engineering and production skills in naval shipbuilding. Today, the group continues to provide the Navy with the modern, sophisticated naval platforms and capabilities that will serve the U.S. well into the future, including: nuclear submarines, surface combatants, and auxiliary ships. We also manage ready-reserve and pre-positioning ships and build large-hulled vessels for select commercial customers.

Global Shipbuilding Industrial Base Benchmarking Survey

In late 2004, the Deputy Under Secretary of Defense for Industrial Policy (DUSD-IP) commissioned First Marine International (FMI) to conduct a *Global Shipbuilding Industrial Base Benchmarking Study* of the major U.S. and top-performing international shipyards The resnlting report, *First Marine International Findings for the Shipbuilding Industrial Base Benchmarking Study, Part 1: Major Shipyards*, was submitted to the House and Senate Armed Services Committees and the House and Senate Defense Appropriations Subcommittees on January 9, 2006, by the Under Secretary of Defense.

The FMI study examined seven major areas of shipyard technology and productivity:

- Steelwork production
- Outfit manufacturing and storage
- Pre-erection activities
- Ship construction and outfitting
- Yard layout and environment
- Design, engineering, and production engineering
- Organization and operating systems

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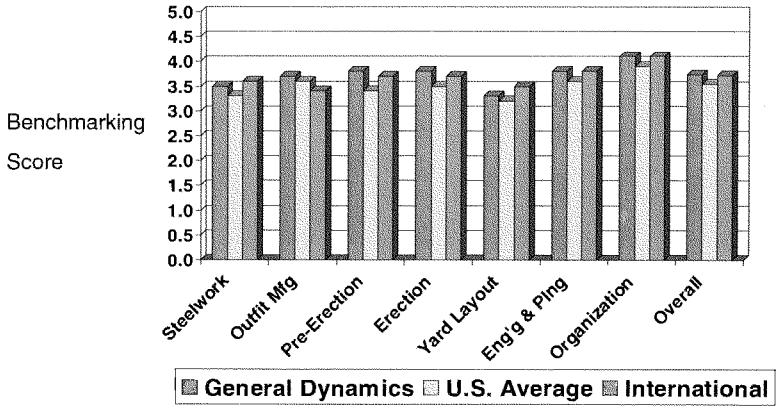
In the three survey areas associated with General Dynamics' key capabilities, (Outfit Manufacturing, Pre-Erection Activities, and Ship Construction and Outfitting), the General Dynamics yards exceeded the international average.

OSD Shipyard Benchmarking Survey



General Dynamics' shipyards exceeded the U.S. average in all seven areas – in five of the seven areas General Dynamics met or exceeded the international average.

GD Marine Shipyard Modernization

In the late 1990's, General Dynamics, in cooperation with the state of Maine and the city of Bath, invested over $300M in a state-of-the-art Land Level Transfer Facility (LLTF) at Bath Iron Works (BIW) to radically improve surface combatant shipbuilding processes. The investment included a new blast and paint building, transporter roadway, modernization to existing buildings, new equipment and of course the LLTF. In 2006, to further leverage the proven benefits of the world-class LLTF, BIW began construction of a new $40M Ultra Hall facility. When completed in 2008, this new building will enable significant increases in the size of erection units and consequent expansion of pre-erection unit completion levels; both improvements will enhance BIW's productivity and reduce costs on future surface combatants.

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Since 2000, Electric Boat has invested almost $200M in capital improvements to its Groton shipyard and Quonset Point manufacturing facility. Recently, Electric Boat invested $70M to repair and modernize its Graving Dock #3, the supporting dock structure for the Groton Land Level Construction Facility. Currently, Graving Docks #1 and #2 are also being repaired and upgraded. The total project cost for these facilities is $65M and is being partially funded by the State of Connecticut through property tax exemptions and low rate loan packages.

Since the purchase of NASSCO by General Dynamics in 1998, significant investments totaling more than $160 M have been made to upgrade production facilities to world class levels.

The three General Dynamics shipyards have used the information provided by FMI to guide their capital expenditure and process improvement activities wherever possible. NASSCO is leveraging the results of internal studies as well as the FMI bench-marking report to identify opportunities for facility on process investments. Early investments were made in steel assembly and an automated profile fabrication line resulting in significant reductions to man hours and cycle time in ship construction. The FMI benchmarking survey scores influenced BIW's investment decisions and provided focus for process improvements. The FMI results were mapped to the production process and emphasis was given to improve stages of construction with high work content. Facilities modernization at Electric Boat has included areas the FMI study highlighted for improvement such as steel processing, warehousing and material flow.

People – Our Key Resource

As essential as facilities, tools and equipment are to building ships, it is the people that are the essential element. They are the key to building ships. This industry demands a tremendous range of specialized skills -- from the naval architects and engineers that design the ships to the tradesmen and women that form tons of steel into the ship's structure, that integrate the latest mechanical and electrical equipment into the ship systems, and that ultimately, with the Navy, take these ships to sea on their initial trials.

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These specialized skills are not readily found in other industries and take years to develop. This is why new shipbuilding orders are critical to the health of the shipbuilding industrial base. In order to attract and retain the next generation of shipyard workers, we must demonstrate that America's shipbuilding industry is healthy and will be a robust environment for them to develop the tools and technologies needed to advance the shipbuilding enterprise.

General Dynamics Marine shipyards are also benefiting synergistically with former Electric Boat executives now in place as presidents of BIW and NASSCO. BIW has implemented the lessons learned from modular submarine construction by moving more work earlier into the construction process and facilitizing for this way of doing business. NASSCO is capitalizing on the strong program management approach developed with the VIRGINIA submarine program.

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ELECTRIC BOAT

Business Overview

Electric Boat Corporation, headquartered in Groton, Connecticut, has been designing and building submarines for the U.S. Navy since 1899. Starting with the first nuclear submarine, the USS NAUTILUS, Electric Boat has delivered 98 of the U.S. Navy's 195 nuclear submarines. Electric Boat has designed 15 and built the lead ship for 16 of the 19 classes of nuclear submarines, and has designed the propulsion plant for all but one class. Today, Electric Boat remains focused almost exclusively on the design, construction, and life cycle maintenance of nuclear submarines for the U.S. Navy and its allies.

Programs

VIRGINIA

The VIRGINIA submarine program is the first U.S. Navy combatant designed from its inception for the post cold war threat environment, and, with a focus on affordability. It is the first fully electronic ship design and the first ship to be designed using a revolutionary design / build process, pioneered by Electric Boat. This unique approach brought shipbuilders, designers, engineers, suppliers, and the U.S. Navy together, throughout the design and construction period, to address the competing demands of performance, producibility, and affordability.

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The Virginia submarine program is currently planned to be a 30 ship program. The ships are being constructed under a unique teaming arrangement with the two nuclear shipyards, Electric Boat and Northrop Grumman Newport News. The lead ship of the VIRGINIA Class, USS VIRGINIA, was delivered in October 2004, within four months of the original schedule established a decade earlier. The ship completed its first deployment in September 2005, and in the words of the commanding officer, "performed remarkably." The second ship, USS TEXAS (SSN775) was delivered at NGNN on June 20, 2006. This was the first submarine delivered at NGNN after a ten year hiatus in submarine construction. The third ship in the program, USS HAWAII (SSN776), was delivered by Electric Boat on December 22, 2006, ahead of its original contract delivery schedule and built for two million manhours less than VIRGINIA. The fourth ship in the program, USS NORTH CAROLINA, is 80 percent complete and is scheduled to deliver toward the end of the year.

Six additional ships under contract in the Block II multi-year procurement are at various stages of construction at Electric Boat and Northrop Grumman Newport News. Electric Boat and the Navy are planning for the next seven ship multi-year procurement, which will include ramping up to a procurement rate of two ships per year in FY12, an essential step in lowering ship unit costs.

SSGN

The SSGN Program is converting four former strategic missile submarines of the Ohio Class to a configuration that provide key capabilities for covert strike and clandestine Special Operations Force (SOF) missions. SSGN provides up to 154 Vertical Launch Weapons from missile tubes previously housing ballistic missiles, an enhanced Virginia Class communications suite and a dedicated command and control space for mission planning, and two Special Operating Forces lockout chambers to host dual Dry Deck Shelters and/or Advanced SEAL Delivery Vehicles. The reconfigured ship will be able to house 66 SOF personnel and provide a dedicated SOF command and control planning center.

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Electric Boat was responsible for the SSGN conversion design, manufacturing of components and assemblies, and installation and test of the conversion elements at Puget Sound and Norfolk Naval Shipyards. The first SSGN, USS OHIO, was delivered back to the Navy in December, 2005 following its conversion at Puget Sound Naval Shipyard. Since that time, two additional SSGNs have been delivered to the Navy, the most recent on November 22, 2006, two weeks ahead of schedule. The last ship of the program, USS GEORGIA, is completing its conversion at Norfolk Naval Shipyard and is expected to deliver in September 2007.

Workforce

The design, construction, and maintenance of a nuclear submarine, the most complex system in the world today, is extremely labor-intensive. There are over 10,000 engineers, designers, and craftsmen at Electric Boat. Their expertise encompasses a myriad of fields, and is the product of decades of experience. Among the many areas where submarine design and construction calls for unique skills and abilities are: acoustics and silencing; arrangement density; atmosphere control; design for depth and submergence; submarine hydrodynamics, nuclear propulsion; pressure hull design; ship control systems; shock; submarine combat system and weapons handling systems; SUBSAFE; and weight engineering.

Electric Boat's workforce is concentrated at the Groton, Connecticut site, home to most engineering and design activity and where ship final assembly, test, and trials occurs. There are also about 2,000 employees at the Quonset Point, Rhode Island manufacturing and modular construction facility. In addition, Electric Boat detachments and road crews support Navy submarine maintenance and modernization at the two ballistic missile submarine bases; Bangor, Washington, and Kings Bay, Georgia; at the four naval shipyards; at the land-based prototype site in upstate New York; and at engineering field offices in Newport, Rhode Island and Washington, DC.

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Facilities

Electric Boat Corporation facilities encompass some of the finest submarine research, engineering, design and construction capabilities in the world. Our engineering and construction facilities, dedicated to submarines, have a replacement value of more than $1.7 billion. Since the start of the Ohio submarine program, Electric Boat has modernized and upgraded our facilities at the Groton shipyard and at our manufacturing center in Quonset Point. These investments provide the Navy with in-place, modern, and proven facilities and trained people.

Electric Boat's Groton shipyard occupies 118 acres along the Thames River in Groton, Connecticut supporting both new construction and maintenance activities. Our Land Level Ship Construction Facility (LLSCF) at Groton, which was the forerunner of domestic and United Kingdom land level submarine construction facilities, has operated since 1974. Built in the early 1970's to support the Trident ballistic missile submarine program, and designed for handling, movement, and assembly of heavy outfitted submarine hull sections into complete submarines, it has enabled Electric Boat to continually improve labor-savings, time savings, and modular submarine construction techniques. On the teamed VIRGINIA program, the LLSCF receives hull sections and modules from Quonset Point and Northrop Grumman Newport News, assembles them into completed submarines, and then positions the ships for float-off using electric/hydraulic transfer cars and a pontoon in the associated graving dock.

Two additional dry docks as well as various piers and shops also support overhaul and repair activities for active submarines, primarily those assigned to the Naval Submarine Base, New London.

At Quonset Point, we have a controlled assembly shop facility for hull section modular outfitting and construction. Our Automated Frame and Cylinder Facility at Quonset Point produces hull sections with unparalleled quality and efficiency. It represents an industrial process breakthrough in submarine hull construction. Quonset Point delivers sections of the submarine to the Groton final assembly site which are upwards of 95 percent complete, incorporating not only components and assemblies, but increasingly systems or sub-systems pre-tested prior to shipment. Electric Boat's Quonset Point facility is located on the site of the now closed Naval Air Rework Facility in Rhode Island. It was established during the 1970's when Electric Boat required additional space to support Ohio and Los Angeles Class submarine production.

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Capital Investment

Since 2000, Electric Boat has invested almost $200M for capital improvements to its Groton shipyard and Quonset Point manufacturing facility. Recently, Electric Boat invested $70M to repair and modernize its Graving Dock #3, the supporting dock structure for the Groton Land Level Construction Facility. Currently, Graving Docks #1 and #2 are also being repaired and upgraded. The total project cost for these graving dock repairs is $65M and is being partially funded by the State of Connecticut through property tax exemptions and low rate loan packages.

At Quonset Point, the facility investments to improve the VIRGINIA Class submarine construction process include a new $12.4M steel processing facility, which was dedicated December 17, 2001, only 13 months after groundbreaking. This 45,000 square foot, state-of-the-industry facility has reduced the time required to process a batch of steel from 5.6 days to 1.3 days. The machinery includes: automated blast machine; laser marker with second side capabilities and plate flipper; water jet, which cuts plate up to eight inches thick; high definition plasma cutter for double-bevels to 1.5" thick; and laser cutter for plates to ¾" thick.

Virginia CAPEX Program

The overarching vision for the VIRGINIA Class Improvement Initiative is to provide greater value to the Navy by reducing the cost of VIRGINIA Class construction. In order to achieve this vision, it is our intent to establish a more affordable and sustainable VIRGINIA Class co-production build plan by leveraging the strengths of respective facilities to realize greater production efficiency; achieve a reduction in total shipyard labor hours for construction; achieve a reduction in cycle time for final outfit, test, and delivery; and improve the combined learning curve efficiency. This initiative is facilitated through the Virginia Class CAPEX Program.

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The Block II VIRGINIA submarine construction contract ties $231M of profit to five specific incentives: labor cost control; material cost control on 35 major components that drive CFE material cost; schedule performance on key construction events; total cost performance; and CAPEX. CAPEX provides profit incentives of up to $91M to the shipbuilders to invest in facilities and process improvement projects that provide cost savings to the program. The contractors prepare a business case analysis for potential projects which is then presented to the Navy for review and approval. Approval is at the sole discretion of the Government and based upon the Government's determination that the proposed project is in the best interests of the VIRGINIA program. Within thirty days after approval by the Government and commencement of a project, a Special Incentive not to exceed 50 percent of the estimated investment cost is paid to the shipbuilder. Upon successful implementation of the project, an additional Special Incentive not to exceed 50 percent of the original estimated investment cost is then paid to the shipbuilder.

To date, $36M of the potential $91M CAPEX incentive payments have been earned by Electric Boat and Northrop Grumman Newport News. Three infrastructure improvement projects at EB have been completed with CAPEX funding

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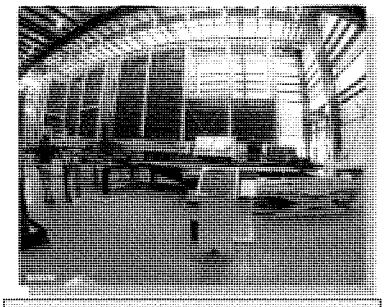
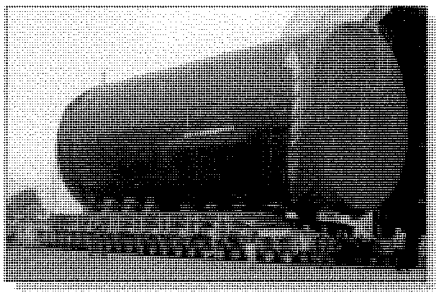
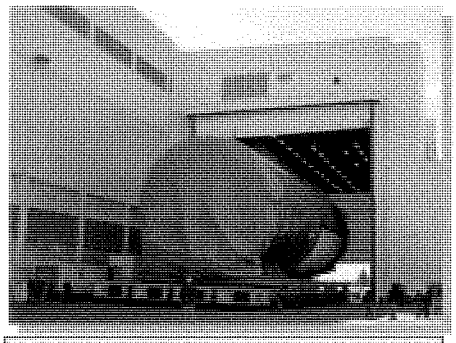


Light Metal Fabrication Facility
$10M Investment--$31M Program Savings



Module Transportation & Facilitization Project
$13.1M Investment--$99M Program Savings



Coatings Facility
$9.4M Investment--$139M Program Savings

The Light Metal Fabrication Facility, the Coatings Facility, and improvement to the Modular Transportation System are three projects completed under the CAPEX Program. These three projects provide over 3 M manhours of savings for ships in the Virginia submarine program.

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The Light Metal Fabrication Facility project is designed to achieve a step change in cost, accuracy, expanded capabilities, and performance of light metal fabrication and structural assembly of VIRGINIA Class components. The savings will be accomplished by the reduction in labor hours performed during the manufacturing and assembly process for light metal assemblies. The scope of light metal fabrication and assemblies work includes ventilation assemblies, joiner type work, stowage & lockers, consoles and special fittings. Ground breaking for the facility took place in November 2004. The facility achieved full on-line capability in November 2005. The state of the art technology and machinery, with its sorting, cutting, punching, bending and shaping capability, is considered the most advanced facility of its kind in the United States. The forecasted gross total Virginia Class cost saving for the $10M investment are $31M. In addition to the cost benefits, the new machines and process flow will help to enhance worker safety while improving the quality of the piece parts, and ultimately the final product, through improved accuracy and precision.

The submarine Coatings Facility is a self-contained, environmentally controlled building with requisite systems and equipment to support cost-effective application of coatings associated with submarine construction in both axis-horizontal and axis-vertical orientations. These coatings include tile and mold-in-place (MIP) special hull treatment (SHT), high solids and traditional epoxy paints, sound-damping, anti-sweat, and various other coatings. The Coatings Facility includes equipment for complete surface preparation of internal ship structures and tanks, main ballast tanks, hull cylinders and ship sections, and a mechanized blasting system for exterior hull surfaces. The Coatings Facility will accommodate improved construction sequence and shorten final assembly time. The Coatings Facility Project will enable a total savings of approximately $139M for the VIRGINIA Class through the investment of ~$9.4M of CAPEX funding.

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The Module Transportation & Facilitization Project will increase the level of submarine modular construction efficiency by developing a transport system and infrastructure that supports modules up to 2,000 tons, versus the previous 1,580-ton system. This project will reduce VIRGINIA Class construction cost by enabling maximum submarine modular construction prior to module transport to the final assembly and test facility. Implementation of this project permits the creation of four essentially complete modules that are shipped to the final assembly facility. The completion of this additional work in a shop environment enables a reduction in construction risk by enabling earlier testing and alignment of critical systems and components. Increased module outfitting increases module weight from 1,580 tons (the heaviest module currently shipped) to ~2,000 tons. Overall module lengths will also increase to a maximum of 120 feet. To accommodate the heavier, longer modules, capital improvements were required to the existing support and transfer / transport system. This increase in efficiency results in approximately $12M cost savings for Block II and approximately $99M over the Virginia Class for an investment of $13.1M.

Reengineering Savings

With the abrupt rescission of the Seawolf program in 1991, Electric Boat was confronted with the challenge of remaining a viable enterprise in the face of a business future where its sole production program had been canceled. Electric Boat responded to this challenge with an immediate and complete reengineering of its business. This was an aggressive plan to ensure successful completion of its backlog of work while positioning the company to remain viable in what was expected to be a dramatically reduced submarine production market. Key objectives were: to be properly sized to meet demand; to utilize "best practices" for all processes and procedures; and to incorporate a culture of world class performance. As a result, Electric Boat has led the industry in shedding excess production capacity, reducing overhead and infrastructure costs, and developing tools and methods to preserve critical skills and capabilities during low rate production.

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One of the most critical steps in the reengineering process was changing the historical relationship between overhead costs and direct labor costs. In 1992, at the outset of Electric Boat's reengineering effort, an aggressive, long range, overhead cost reduction target was established for 1998. A plan was laid out that included significant reductions in overhead cost each year. Electric Boat's realization of its goals necessitated identifying key cost areas, breaking each one down into discrete elements, and, most importantly, taking aggressive management actions to minimize these costs. These actions have resulted in actual and projected cost savings of over $2.7B over 1993 through 2010; $1.7B from 1993 – 2004, and $1.0B from 2005 – 2010. Over 95 percent of those savings have or will accrue to the Government.

Labor Efficiencies, Learning Achieved, LEAN

Electric Boat is proud of our culture to continuously improve our products and processes. We are in our fifth year of applying Lean Six Sigma tools to the entire submarine design, construction, test, and repair process. To date, we have trained over 500 Electric Boat employees in Lean Six Sigma. Lean Six Sigma at Electric Boat is deployed enterprise wide with a strong focus on leadership development, process management and, most importantly, employee engagement.

In 2006, Electric Boat completed 131 Lean Six Sigma projects producing a net hard savings of $16.2M. We also have 223 more projects in process. This resulted in a program return on investment of over 6:1.

Electric Boat has trained over 150 employees in Lean Six Sigma black belt or green belt skills and over 380 management personnel in the tools for Process Management. This investment is now paying off in just about every facet of Electric Boat, from reducing the cost of new construction to improving performance on overhaul and repair activities.

Electric Boat is working closely with industry partners, the Government and our suppliers to make submarine design, procurement and repair more affordable.

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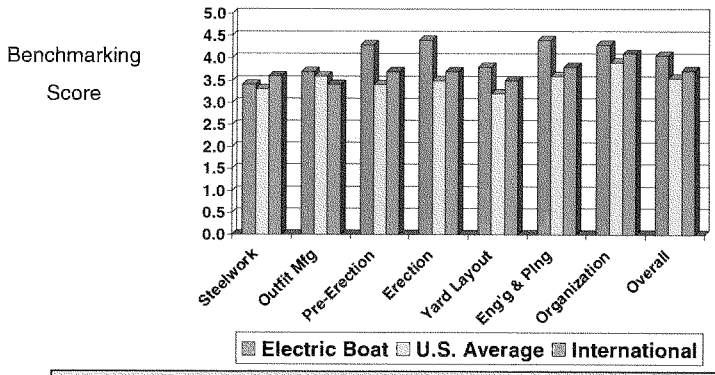
Global Shipbuilding Industrial Base Benchmarking Survey

Similar to the performance already discussed for the three General Dynamics shipyards as a group, the results of the *First Marine International Findings for the Shipbuilding Industrial Base Benchmarking Study, Part 1: Major Shipyards* found Electric Boat to be a world-class performer.

In all seven areas of shipyard technology and productivity, Electric Boat exceeded the U.S. average, and in six of the seven areas Electric Boat exceeded the international average. In fact, in two of the areas Electric Boat scored higher than any international yard, and equaled the top international performance in four others. The one area where Electric Boat did not excel, steelwork production, was the result of having older, less automated technology in the plate and shape storage and handling categories, an area FMI explicitly stated was at the correct level of technology given the limited value of steelwork in a submarine as compared to a commercial vessel. FMI noted that "to achieve the lowest cost, a shipyard needs to have an appropriate level of technology for its cost base, its product mix and throughput. The extent to which the use of best practice influences productivity in a particular area is related to the proportion of man-hours spent in the area."

OSD Shipyard Benchmarking Survey



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Looking to the Future

The VIRGINIA Class Program is well on its way to becoming a benchmark DoD acquisition program in terms of cost, schedule and performance. With three ships delivered and construction progressing smoothly on the remaining ships currently under contract, VIRGINIA is a mature program with demonstrated success. As a mature program, it is not subject to the risks inherent in new development programs and it is incumbent on the shipbuilders to focus their efforts on program execution and unit cost reduction. To this end, Electric Boat and Northrop Grumman Newport News are sharply focused on achieving the VIRGINIA cost challenge. Our effort is focused around four key initiatives:

- Reducing the construction schedule from 84 months to 60 months, facilitated by improved construction and material planning systems, with enhanced manufacturing, modular assembly, and final assembly and test;
- Achieving learning efficiencies in a low rate production environment, by maximizing workforce stability of the shipbuilders and across the submarine supplier base, and applying Lean Six Sigma and lessons learned across all processes a the yards and suppliers;
- Improving the design to remove inherent costs and enhance mission capability, with limited ship redesign aimed at reducing material cost and improving production efficiencies;
- Implementing an acquisition strategy that supports efficient material procurement and construction, utilizing Advance Procurement (AP) and Economic Order Quantity (EOQ) funding to reduce material costs and achieve construction schedule reduction. Also, maximizing the savings afforded by multi-year procurement.

Achieving this goal requires establishing a more affordable and sustainable VIRGINIA Class co-production build plan by leveraging the strengths of respective facilities to realize greater production efficiency; achieve a reduction in total shipyard labor hours for construction; achieve a reduction in cycle time for final outfit, test, and delivery; and improve the combined learning curve efficiency by the end of Block II construction.

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BATH IRON WORKS

Business Overview

Bath Iron Works, located on the west bank of the Kennebec River in Bath, Maine, delivered its first ship to the United States Navy in 1893 and has continued that proud tradition to this day. Since that date, BIW has delivered over 400 ships, including 245 military ships and more than 160 commercial vessels and private yachts. Most recently, BIW received its first commercial contract in twenty years and is working jointly with another company on an offshore supply vessel conversion.

Major Construction Programs

At present, BIW is participating in three design and construction programs that constitute the Navy's premier surface combatant construction programs for the next decade. Given the planned low procurement rates for these warships, BIW is pursuing other ship construction opportunities beyond the traditional Navy customer.

DDG 51

BIW is the lead designer and builder for the DDG 51, Arleigh Burke Class of destroyers that have been BIW's mainstay construction work since 1987. To date, BIW has delivered 27 of these ships and will build a total of 34 of the 62-ship class. DDG 112, the last ship of the Class, will begin fabrication in July 2007 and BIW will deliver the ship in the first quarter of 2011. BIW not only builds the DDG 51 Class ships, but also works closely with Northrop Grumman Ship Systems (NGSS) of Pascagoula, MS, the follow yard builder, and the Navy as the class design agent. In addition, BIW provides support for the ships currently operating in the U.S. Navy fleet under the Planning Yard contract for the Class. BIW provides "cradle to grave" support to the Navy for the Arleigh Burke Class of destroyers.

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DDG 1000

BIW is actively involved in all engineering and design aspects of the DDG 1000 along with NGSS and other government and industry team members. BIW and NGSS were each awarded contracts in August 2006 to each perform approximately half of the detail design. The industry team is leveraging state-of-the-art technology and industry best practices, specifically the collaborative design/build approach developed by Electric Boat on the Virginia program, to deliver a superior surface combatant design ready for construction. BIW anticipates starting fabrication for its first ship in mid-2008.

LCS

BIW leads the GD LCS team providing program management, planning, technical management, contract administration, design and construction support. Construction of the first GD LCS began in November 2005 and the keel was laid on 19 January 2006 at teammate Austal USA's facility in Mobile, Alabama. In addition to the work being performed in Bath, BIW currently has approximately one hundred craftspeople, engineers and managers located in Mobile supporting the program. The team is focused on the challenges of lead ship construction and getting the first ship to sea. When delivered in mid-2008, the GD LCS, an innovative trimaran design, will provide a new, revolutionary capability to the naval surface fleet.

Workforce

BIW produces the world's most sophisticated surface combatants, which require a wide array of specialized skills from the naval architects performing concept design to shipyard mechanics bringing the ship to life. While appropriate facilities are an important component of successful ship production, maintaining the capacity for innovation and skills of the workforce is paramount to the health and viability of the shipbuilding industrial base. BIW's skilled workforce has an average of twenty years experience in the engineering, design and manufacturing ranks. Care must be taken as the surface combatant construction programs enter low-rate production that these perishable, highly-experienced core shipbuilding skills are maintained in the face of retirements and reductions-in-force due to decreased workload.

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BIW is one of Maine's largest private employers and plays a significant role in the state's economy. Driven by decreasing shipbuilding volume and efficiency gains within the shipyard, BIW's employment has fallen from approximately 7,900 employees in 2000 to about 5,600 through the beginning of 2007 – a decrease of almost 30 percent.

Facilities

BIW is located on 73 acres in the city of Bath and is supported by offsite fabrication and warehousing facilities. Beginning in the late 1980s, BIW made numerous capital investments to support the start of the DDG 51 program including construction of an outfit fabrication facility, a building hall for large unit construction and a climate-controlled warehouse. Additionally, a 300-ton crane and a 450-ton transporter to move large units around the shipyard were also purchased. The next major recapitalization began in the late 1990's after General Dynamics' acquisition of BIW. General Dynamics, in partnership with the state of Maine and the city of Bath, invested over $300M in a state-of-the-art Land Level Transfer Facility (LLTF) at Bath Iron Works to dramatically improve the shipbuilding process. The investment included the LLTF, a flat, 15-acre facility to support the assembly and launch of ships; a floating dry dock to launch the ships; the Manufacturing Support Center which co-locates manufacturing management and support personnel, as well as warehousing and support services on the LLTF in close proximity to the ships under construction; a new blast and paint building; and modernization to other existing infrastructure. The size and throughput capacity of this flexible, world-class facility was established in cooperation with the Navy based on the FY99 projected surface combatant plan that was significantly higher than today's lower-rates of production.

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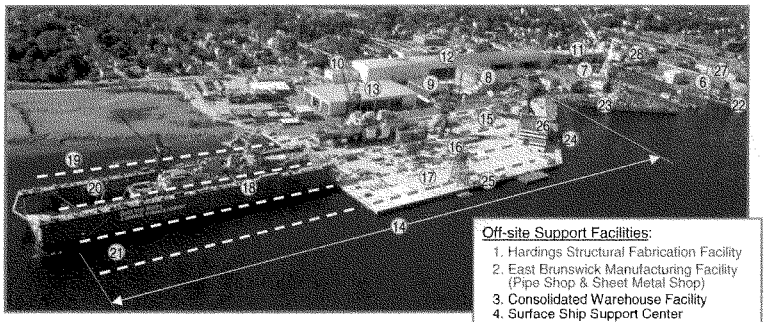
Fundamentally, the LLTF allows work to be moved to earlier, more efficient stages of construction where access to equipment is less congested and support services are more readily available. The LLTF eliminates weight and size restrictions formally imposed by the inclined ways method of construction. Shipyard workers build and outfit increasingly larger combinations of hull "units"— sections of ship complete with piping, cabling, and equipment—inside climate-controlled building halls that are then joined into complete ships on the LLTF. Outfit Support Towers on the LLTF provide workers with multi-level access to the ship and contain offices, work shops, tool rooms, lockers and food service areas to keep services required by the shipbuilders convenient to the job site. The LLTF investment allows the ship to be built more efficiently with more final construction work and outfitting completed while the ship is still out of the water. When the planned level of pre-launch work is completed, the ship is translated from the LLTF onto a floating dry dock and becomes waterborne for the first time. The following figure shows the physical arrangement of the main shipyard.



Off-site Support Facilities:
1. Hardings Structural Fabrication Facility
2. East Brunswick Manufacturing Facility (Pipe Shop & Sheet Metal Shop)
3. Consolidated Warehouse Facility
4. Surface Ship Support Center
5. Church Road Office Facility (Technical)

6. Production Shops
7. Erection Plattens
8. Blast & Paint Facility
9. Small Assembly Building
10. Panel Line
11. Aluminum Shop
12. Main Assembly Building
13. Pre-Outfit II Building
14. Land Level Transfer Facility
15. Ship Way #1
16. Ship Way #2
17. Ship Way #3
18. Floating Dry Dock
19. Dry Dock Landing Grid #1
20. Dry Dock Landing Grid #2
21. Dry Dock Landing Grid #3
22.-25. Outfitting Piers
26. Manufacturing Support Center
27. Engineering Building
28. Main Office & Administration Buildings

Key:
Fabrication
Pre-Outfit
LLTF
Ships Completion
Other

General Dynamics, in cooperation with the state of Maine and the city of Bath, invested over $300M in a state-of-the-art Land Level Transfer Facility to radically improve the shipbuilding process.

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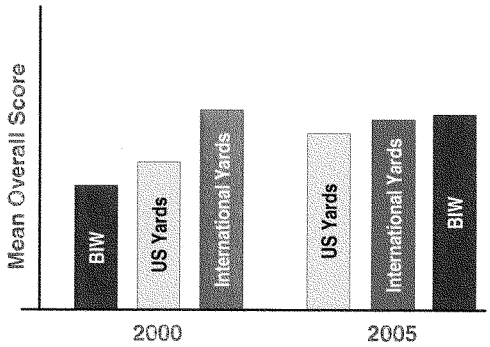
In addition to the macro shipbuilding process changes associated with the activation of the new facility in May 2001, myriad lower-level improvements associated with lean manufacturing principles have been continuously introduced due to the innovative spirit of BIW's skilled mechanics and managers. Some of BIW's surface combatant "firsts" include "lighting-off" the ship's generators before launch; aligning the main propulsion power train before it is water-borne; using photogrammetry, a technology principally developed for surveyors and cartographers, to aid in equipment and structural alignment; and reducing the number and length of sea trials.

Global Benchmarking

As previously described, in early 2005 the Deputy Under Secretary of Defense – Industrial Policy (DUSD-IP) conducted a global shipbuilding industrial base benchmarking study as a follow-up effort to a similar study conducted in 2000. In the 2000 study, BIW was ranked below the U.S. average and international yards were well ahead of BIW and other U.S. yards. The LLTF under construction was not reflected in the scores since it was not yet operational. When the study was repeated in 2005, it showed that BIW had risen above the U.S. average in the use of best practices and was slightly above the international average as seen below.



BIW's use of shipbuilding best practices has increased to world-class levels during the past five years.

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BIW has used the benchmarking survey scores throughout the shipyard to provide focus for additional process improvements as well as to influence future investment decisions. The benchmarking category scores were mapped to BIW's production process and greater emphasis was given to further improve those stages of construction with high work content to maximize productivity improvements. Similarly, investment decisions have been made to increase the use of best practice in areas which will have the greatest effect.

Mega Units

Subsequent to the Global Benchmarking study, additional productivity and process improvements were identified as the new LLTF production processes matured. Consistent with BIW's construction strategy of moving work to earlier, more efficient stages of construction, the next logical step was to build and outfit larger units, referred to as Mega Units. Mega Units are created by joining smaller units together inside a building, enabling the installation of a majority of the equipment before being transported to the LLTF for erection. These Mega Units weigh as much as 1,400 tons, versus the 450-ton units on earlier LLTF ships. By moving work that was once performed outside on the LLTF into a climate-controlled facility where shipbuilders have better access to the individual units, BIW was able to achieve greater construction efficiencies in a safer work environment. The first two mega units were completed in 2006 and produced significant productivity improvements on the first hull. This strategic improvement to ship production at BIW was the result of innovative mechanics, supervisors and planners continuing to exploit the value of the LLTF investment and leveraging the collective assets of GD Marine. Mega Units required little capital investment because EB had purchased large transporters under the previously-described Virginia CAPEX program to move similarly large submarine units. The transporters are easily moved over-the-road between Maine and Connecticut and are shared by BIW and EB, avoiding the need for additional equipment investment.

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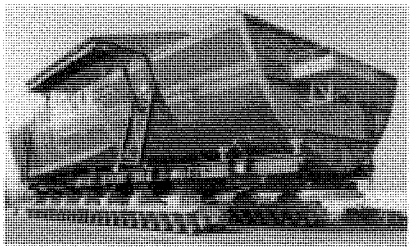

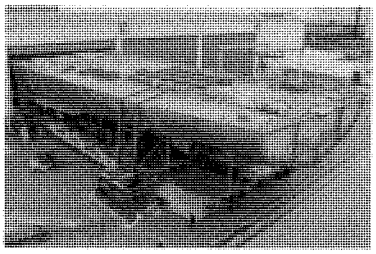

Mega Units enable more efficient use of the of the LLTF by moving work to earlier, more efficient stages of construction

Performance Improvements

The LLTF investment, combined with the innovation and skill of BIW's workforce, has dramatically decreased the number of hours required to construct a destroyer. Today, it takes 1 M fewer labor hours to build a DDG at BIW today than it did just four ships ago. This is a significant accomplishment given the late stage of the DDG 51 program with 27 ships, or 80 percent of BIW's total number of ships, delivered and at the point when learning curves traditionally predict minimal ship-to-ship savings. It is important to note that even though the cost savings have been dramatic, quality has been maintained. In fact, the Navy inspector aboard the most recent sea trials for DDG 101, USS GRIDLEY stated, "Overall performance could not have been better." The net result is an affordable, quality ship for the U.S. Navy.

Ultra Hall Investment

Building on the Mega Unit concept, BIW identified further process changes that will continue to improve shipyard efficiency and reduce costs. The next big step is to construct even larger ship sections, known as Ultra Units. However, units of this size exceed the size and weight restrictions of BIW's current facility and, given the business environment changes since BIW's last major capital investment, industry's ability to invest independently is much more limited. With the prospect of a decade of low-rate procurement plans for major warships, this business environment does not support near-term investments for the potential of a longer-term return - a difficult and uncertain prospect for shareholders, given historical instabilities of procurement plans. Despite these unfavorable market conditions, BIW, in cooperation

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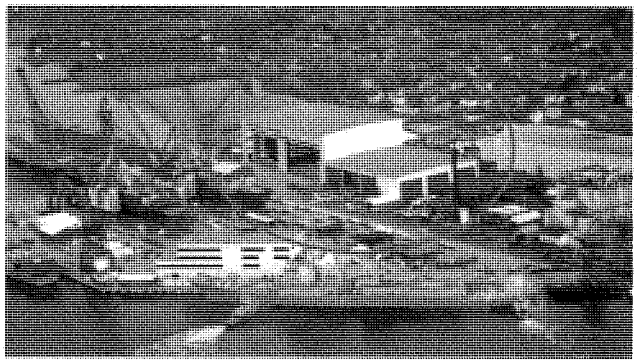
with the Navy, was able to develop the business case to justify General Dynamics' investment in the $40M Ultra Hall facility with capacity to build Ultra Units up to 5,000 tons each. This decision was based on the strength of BIW's demonstrated performance improvements and the prospect of continued, sustained improvements on the remaining DDG 51 Class ships. Given that this substantial capital investment will result in lower total costs to the Navy, BIW and the Navy agreed to change contract terms to allow BIW to reinvest the resultant savings in the construction of the Ultra Hall facility.

The Navy will see reduced costs on the final ships of the DDG 51 Class —DDGs 111 and 112—and BIW expects to save approximately $340M in total future surface combatant construction costs using the Ultra Unit concept. The timing of the investment is important to BIW. Not only will the new facility benefit the DDG 51 Program, but it will also allow BIW to refine the techniques necessary to construct and integrate even larger ultra units reqnired for the DDG 1000 Class. The following figure shows the taller, new Ultra Hall facility next to the existing pre-outfit building.



The $40M Ultra Hall Facility will further enhance BIW's productivity and reduce costs on future surface combatants.

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Design Best-Practices

In addition to construction process changes and facility modernization, BIW is committed to developing an efficient, producible DDG 1000 design. The key to achieving this goal is leveraging design-build and best-practice approaches to outfit modularization and integrated engineering methodologies pioneered on the Virginia Program. In addition, we are applying standard engineering best-practices, such as Lean Six Sigma. Essential ship production knowledge and skills are concentrated in the manufacturing division and must be captured early in the design process to ensure that the design not only meets technical requirements but also is efficiently produced. The challenge was to define a new design strategy and supporting organization that would enable integration of this knowledge into the pre-production areas with specific emphasis on embedding the production processes in the production design information. This has been accomplished using design-build teams with membership drawn from the engineering, design, planning and production disciplines so best-practices are embedded into the design product from the outset and rework minimized. This process is being used across the DDG 1000 Design-Build Team by key participants from NGSS, EB, and the Navy and employs a common, comprehensive design-build strategy and established written production guidelines to ensure the final design can be built efficiently in both shipyards.

Re-Engineering

BIW has continuously re-engineered all aspects of its business since being acquired by General Dynamics in 1995. When the DDG 1000 procurement rate dropped to one ship a year in 2005, BIW took aggressive actions to become more competitive and affordable in preparation for lower rates of ship construction. These actions included right-sizing the workforce across all functions within the company, reducing paid holidays and lost time, eliminating salaried severance and reducing overhead. Re-engineering actions are continuously revisited to ensure maximum cost savings are being achieved and industry best practices are in place without compromising product quality.

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Looking to the Future

When construction completes in 2008, the Ultra Hall facility will further leverage the proven benefits of the world-class LLTF and enhance BIW's productivity. In general, investment incentives create allow investment risk, along with the resultant savings, to be shared between industry and the government. The Ultra Hall project is an example of how government and industry cooperation, to the mutual benefit of each party, can result in successful facility modernization despite a procurement environment that is not conducive to large, independent capital investments.

The capacity for innovation of the BIW workforce, combined with the collective resources of GD Marine and external efforts like the Global Benchmarking study will continue to refine existing processes and identify new areas for focus and investment. The result will be a modernized shipyard providing affordable, quality ships to the U.S. Navy. BIW has a strategic facilities plan for future investment should additional means become available to upgrade existing equipment and facilities or construct new ones. Some examples of future potential investments are:

- Build new modernized fabrication facilities located within the main shipyard to incorporate new, more efficient steel cutting and forming technologies and eliminate over-the-road transportation and size restrictions imposed by the current offsite facility.
- Construct a larger blast and paint facility to accommodate larger units prior to being joined in the Ultra Hall facility. This new facility would also enable more effective application of high-solids paint, an increasing requirement in naval construction, in a climate-controlled environment.
- Upgrade welding equipment to state-of-the-industry machines to significantly improve existing processes to gain additional savings.

BIW is committed to improving overall shipyard productivity. Through investments in people, processes and facilities, the shipyard is focused on being a capable, nimble, affordable provider of quality surface combatants.

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NASSCO

Business Overview

National Steel and Shipbuilding Company, NASSCO, in San Diego has been designing and building ships for almost 50 years and is the only remaining private shipyard on the west coast capable of building large, ocean-going vessels. NASSCO, with its 4500 engineers, designers, and skilled shipbuilding craftsmen is the largest industrial manufacturer in the San Diego area and is a strategic resource to both the Navy and Southern California.

NASSCO specializes in a product mix of Jones Act commercial wet and dry cargo ships and Navy auxiliary/underway replenishment ships. Fifty-eight commercial vessels and fifty-five large naval auxiliaries have been designed and constructed at NASSCO since 1961. The commercial ships include large crude carriers, product tankers, break bulk ships, container ships, trailer ships and others. The naval auxiliaries include ships for the Combat Logistics Force (CLF), amphibious ships, destroyer tenders, hospital ships, and a variety of strategic sealift and other support ships. In addition, one quarter of NASSCO's business activity is devoted to maintenance and repair of the Navy's fleet home ported in San Diego. NASSCO, working together with the Navy has developed the most effective mode of Navy maintenance in the country, the Multi Ship, Multi Option (MSMO) contract, which ensures the ships stationed in San Diego get the good quality maintenance at the right time and at the right price.

Importantly, NASSCO, with its well-developed new construction capability, is the only private shipyard on the west coast that can perform major battle damage repair or major structural modifications to Navy ships.

Programs

T-AKE

The T-AKE 1 LEWIS & CLARK Class dry cargo / ammunition ship is the latest in NASSCO's long line of Navy auxiliary ships. It is the first new underway replenishment ship design in more than twenty years. Using computer modeling and simulation design tools and proven off-the-shelf state-of-the-art

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commercial marine systems, NASSCO's T-AKE design incorporates a highly efficient cargo handling system and a low life-cycle-cost electric drive propulsion system. NASSCO delivered the first ship, USNS LEWIS & CLARK in June of 2006. T-AKE 1 has been undergoing extensive operational evaluation with US Navy off of the east coast. The results to date have been extremely positive. Cargo transfer rates achieved for Connected Replenishment (CONREP), Vertical Replenishment (VERTREP) and Fueling at Sea (FAS) all exceeded ORD requirements, in some cases by more than 50 percent. The Military Sealift Command (MSC) has asked for delivery of follow on ships as quickly as possible. NASSCO delivered the second ship, *USNS SACAGAWEA*, just last week on 27 Feb 2007 and has plans to deliver two more T-AKEs to MSC in 2007. Five additional T-AKEs are currently under contract at various stages of construction. Options for five more ships are expected to be awarded in the near future, bringing the total potential for the class to fourteen ships.

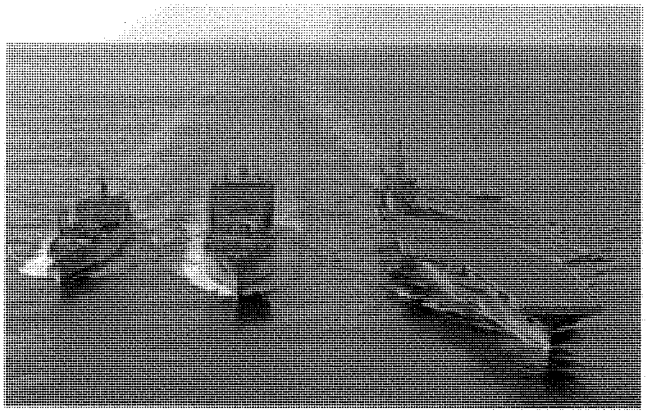

Figure 1 – *USNS Lewis and Clark* (T-AKE 1) underway replenishment of *USS Theodore Roosevelt* (CVN-71) and *USNS Mount Baker* (T-AE 34) simultaneously

Underway Replenishment and Strategic Sealift

NASSCO is a leading builder of underway replenishment and strategic sealift ships. From the AFS combat stores ships to the AOE gas-turbine-powered carrier strike group combat support ships, from the Large Medium Speed Roll-on/roll-off (LMSR) sealift ships to the most current T-AKE, NASSCO-built

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ships are an essential element of the Navy's ability to operate throughout all regions of the world, independent of shore-based support. The considerable experience gained in each of the Navy's past combat logistic ship and sealift ship program in the areas of design and production ideally positions NASSCO to be a principal contributor on the Navy's forthcoming Sea Basing program. The last three T-AKEs will be built to support the Maritime Pre-positioning Force, Future (MPF(F)). Three new LMSRs are planned based on the original design but with significant added capabilities including an enhanced flight deck and more habitability spaces. Three, large heavy-lift ships, designated the Mobile Landing Platform (MLP), are envisaged as staging areas for the transfer of vehicles, cargo, ammunition and operators from logistics ships to combat craft prior to debarking from the Sea Base and proceeding to the landing beaches. NASSCO stands ready to support the needs of the MPF(F) or any other US Navy auxiliary program foreseen to meet future requirements.

Commercial – PC-1

NASSCO has built more of the country's commercial oil tankers than any other shipyard today. Currently, NASSCO is working through the final design stages of a series of nine double hulled, Handy-max sized product carriers for US Shipping. These ships will haul refined petroleum products or chemicals in the Gulf of Mexico. NASSCO has teamed with the second largest shipbuilder in the world, Daewoo Shipbuilding and Marine Engineering (DSME) of Korea, to offer our domestic customers a proven quality design, built in the United States, without paying first of class prices. The design is based on two existing classes of product carrier currently in service overseas but tailored to take advantage of the build strategy that best fit the facility at NASSCO in San Diego. Construction will begin in the summer of 2007 with keel laying for the first ship in December, 2007.

NASSCO continues to look for additional opportunities for replacement tonnage or new markets in the commercial Jones Act fleet including additional product carriers, container ships, trailer ships, shuttle tankers, and others. Commercial shipbuilding brings tremendous benefits to the Navy and the nation including:

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- Allows shipbuilding and ship design technology benchmarking against the best in the world; not just the best in the U.S.
- Ensures access to the best of international marine technology and competitive prices for commercial marine systems that are found aboard many Navy ships
- Creates a steady order book when combined with Navy programs to mitigate cyclical nature of business thus preserving and enhancing the employment skill level necessary to build ships
- Commercial volume allows for the continuous process improvement in construction technique
- Helps attract a necessary new generation of engineers into shipbuilding
- Spreads yard overhead costs across a wider base making Navy ships less expensive

Any assistance, such as, Title XI loan guarantees, that can be brought to bear to increase the number of commercial ships built in this country will pay great dividends in the future. Some of our commercial customers have been forced to secure financing at exorbitant interest rates to fund replacement tonnage. Title XI would allow stable operators in proven markets to replace existing Jones Act tonnage at reasonable rates with relatively small outlays from the government.

Facilities

Since the purchase of NASSCO by General Dynamics in 1998, significant investments totaling more than $160M have been made to upgrade production facilities to world class levels. Although some benefits from these new facilities were realized on the TOTE and BP ships delivered earlier this decade, the true beneficiary is the Navy's new, T-AKE dry cargo/ammunition ships, future auxiliary ships and future commercial contracts.

NASSCO is leveraging the results of internal General Dynamics and international bench-marking studies (First Marine International (FMI) 1999 and 2004) to identify opportunities for strategic investment. Early investments were made in steel assembly and in an automated profile fabrication line resulting in significant reductions to required man hours and cycle time in early stages of construction. Two additional cranes were added enabling larger lifts (~300 tons individually) to facilitate an increase in the

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size and outfit completion percentage of erectable blocks. In the most recent 2004 FMI study (see Figure 2), NASSCO leads the US shipbuilding industry and is approaching the international average in steel production, a significant improvement since the 1999 study.

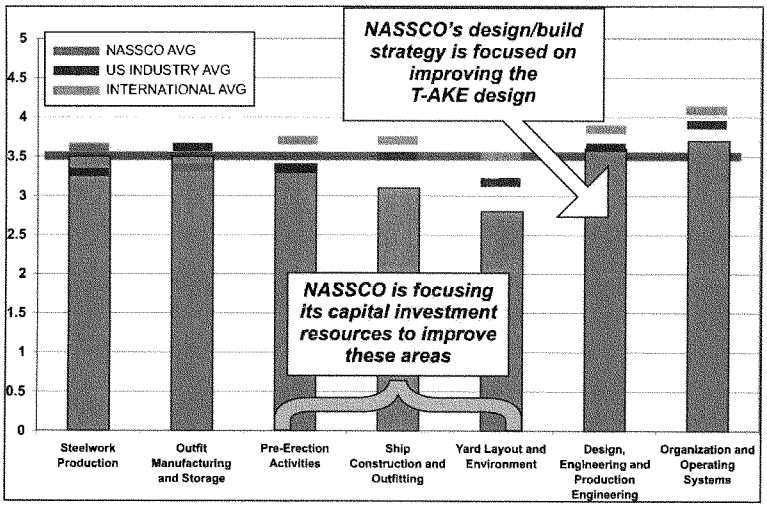

Figure 2 – 2004 NASSCO FMI Study Results

As depicted in Figure 2, recent capital infrastructure improvements have been focused on weaknesses pointed out in the 2004 FMI study: pre-erection activities, ship construction and outfitting and yard layout and shipbuilding environment. These initiatives will result in an increase in the percentage of outfitting achieved prior to erection and improved process flow in the shipyard. Improvements to yard layout have increased the number of on-ground outfitting positions by more than 50 percent, greatly supplementing NASSCO's ability to build grand blocks.

NASSCO will continue to conduct self-evaluation and benchmarking within the GD Marine Group and participate in DoD sponsored benchmarking studies. In addition, our partnership with a world class

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shipbuilder, DSME, has enabled us to spend a considerable amount of time discussing best practices and challenging existing processes. NASSCO will continue to maximize the on-ground outfitting footprint through internal rearrangement and, potentially, the lease of the Navy property contiguous to the southern boundary of the shipyard. This property would enable the development of a new inverted block outfitting lane and a dedicated blast and paint facility, greatly reducing cycle times for painting onboard. We will continue to eliminate current shipyard bottlenecks, maximize work performed off ship and focus on transitioning from a vertically integrated manufacturing facility to a lean shipbuilding assembly facility in the future facilities plan, Figure 3.

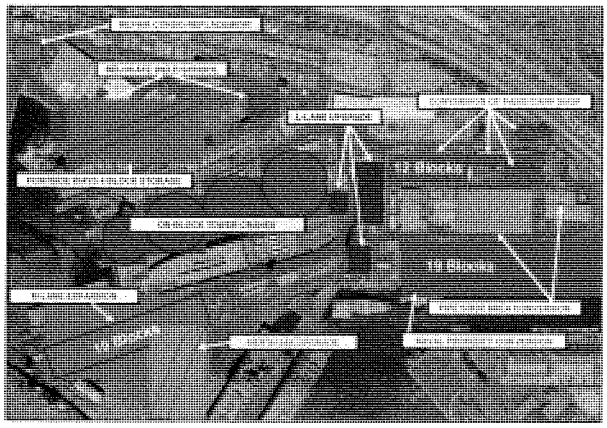

Figure 3 - Strategic Facilities Plan

Capital investment to improve efficiency and reduce cycle times is not the only way NASSCO is reducing the cost of ships. NASSCO continues to focus on Design for Producibility and improvements in our Build Strategy for both the T-AKE and the PC-1 programs. This effort has been demonstrating excellent return on investment and the overall learning curve for the T-AKE program, represents one of the best NASSCO, or any other domestic shipyard, has ever achieved.

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T-AKE Learning Curve

The establishment of business relationships that bring international shipbuilding best practices to NASSCO has provided fertile ground for more efficient practices and ship design. Improvements in structural design, yard layout, and outfitting suggested by our international partners are bearing fruit on a daily basis resulting in cycle time and cost reductions Additional Navy funding is being sought to maximize potential savings on the T-AKE design and to sustain an experienced design/build team until the next large design effort for the US Navy.

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Summary

Shipyard Modernization

It is critical that America's shipbuilding infrastructure continue to modernize and advance the construction process in order to provide the nation with technically superior and affordable naval platforms, Towards that end, there are several initiatives that Congress, the Navy and industry can explore:

- Capital investment incentives – whether contractual or legislative. Industry investment in its shipyards must measure the return on this investment against a range other investment options. Low rate procurement does not support large capital investments for the potential of a longer-term return. Investment incentives, similar to the VIRGINIA CAPEX program, can be a key enabler to encourage future investment in America's shipyards.

- Program and funding stability in the Navy's Plan - Key business decisions related to facility modernizations must be made years in advance of when they are required. These decisions must be predicated on reliable workload forecasts to justify expenditures. Absent a predictable plan, the industrial base can not fully leverage its capabilities and competencies that provide the Navy with the most affordable ships possible. Stability is a critical factor in a business that, for all intents, has but one buyer.

- Alternative financing approaches may give the Navy enough budgetary flexibility to sustain their procurement strategy and support their national defense obligations. The appropriate financing approach will likely vary from program to program, but advance appropriations, multi-year procurements, incremental procurement, split funding and lead ship R&D procurements all potentially offer budget flexibility to the Navy, thereby creating the opportunity for industry to reliably predict volume, and thus provide more cost fidelity for future work.

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- Integrating Research and Development with the Design/Build approach. This is the next step to advance naval ship design and construction technology. Revolutionary manufacturing technologies often reach the prototype stage, but rarely cross over from prototype to full scale deployment into major manufacturing programs where they would have the most significant impact on cost. We believe there is significant benefit to increased funding and better alignment of Navy R&D for mature as well as developmental shipbuilding programs. Towards that end, the Virginia Design for Affordability effort could be expanded to include these technologies. Furthermore, as Design for Affordability experience is gained, the effort could provide a model to apply the same technologies and interactive, cost-sharing approach to the design development and construction programs for all other major naval new construction programs.

- Volume – While stability and predictability are key, volume in the form of increased new construction orders is critical to the health and well-being of the nation's shipyards. The surface combatant outlook is very similar now to what the submarine outlook was in the 1990's, it is facing prolonged low rate procurement.

- An Enterprise Solution - We need to look closely at our policies and plans for accomplishing maintenance and modernization work. In a low rate production environment this work can play a much more important role in preserving our production capabilities. By performing more of this work at the ship construction yards, we will strengthen these yards by sustaining critical shipbuilding skills and capabilities. In addition, we will reduce the cost of new construction by utilizing existing capacity and facilities and spreading overhead costs over a greater volume of work.

- Revitalize commercial shipbuilding in the U.S. - The establishment of business relationships with DSME of Korea is bringing international shipbuilding best practices to NASSCO and has provided fertile ground for more efficient practices and ship design. Improvements in structural design, yard layout, and outfitting suggested by our international partners are bearing fruit on a daily basis resulting in cycle time and cost reductions.

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The goal of General Dynamics Marine Systems is to be the best at what we do, whether that is submarines, surface combatants, naval auxiliaries or commercial ships. Toward this end, the General Dynamics Marine management team remains committed to driving costs from our products, whether through basic process improvements or through major capital investment, when warranted. We will continue to work with the Navy and the Congress to identify potential funding and / or program management alternatives that offer mutual benefits to all parties. Most importantly, we remain dedicated to delivering the highest quality, affordable products to all of our customers.

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STATEMENT OF

DR. MARK L. MONTROLL

PROFESSOR

INDUSTRIAL COLLEGE OF THE ARMED FORCES

NATIONAL DEFENSE UNIVERSITY

BEFORE THE

HOUSE ARMED SERVICES COMMITTEE

SEAPOWER AND EXPEDITIONARY FORCES SUBCOMMITTEE

HEARING ON

U.S. SHIPBUILDING INDUSTRIAL BASE

MARCH 20, 2007

Chairman Taylor, Representative Bartlett, distinguished members of the subcommittee, thank you for the opportunity to appear before you to discuss my views on the current state of the shipbuilding industrial infrastructure in the United States and how it supports the National Defense Strategy. As requested, following a quick introduction, my testimony will first focus on my observations and views of the following:

- The infrastructure differences that my students and I have seen on our visits to various shipyards around the world. In particular, I will address the efficiencies of foreign shipyards in their physical lay down, automation of equipment, and control of secondary supply.
- The differences in complexity of warships which are procured at low rates, and commercial vessels with standard, and less complex designs.
- The value in the Government investing in shipyard infrastructure to increase producability and decrease man-hours.

I will then discuss my opinions and recommendations concerning the following questions:

- What are the best investments the Government can take to help improve efficiency?
- Is it in the economic best interest of the shipyards to become efficient without some form of government subsidy?
- Where can efficiencies be found in the construction process?

Introduction:

My name is Mark Montroll. I am a professor at the National Defense University's Industrial College of the Armed Forces. Before joining the faculty at the Industrial College, I served as a Director of Innovative Technology Initiatives at the Naval Surface Warfare Center's Carderock Division, a Branch Head in the Seawolf Submarine Program Office at the Naval Sea System's Command, and as an acoustics engineer at the David Taylor Naval Ship Research and Development Center. I hold a PhD in Acoustics and a Master's degree in Electrical Engineering from the Catholic University of America as well as a Bachelor's degree in Engineering and Applied Sciences from the University of Rochester.

I have served as the director of the Shipbuilding Industry Study class at the Industrial College of the Armed Forces for the past nine years. Each year, the students in the class are tasked to study the industry and its interaction with the government, assess its current condition, and evaluate its ability to support current and future National Security Strategy requirements. Each year, at the conclusion of their studies, the students are asked to articulate their findings and to develop a set of strategic-level, actionable policy recommendations the government can adapt to ensure the shipbuilding industry will continuously support our National Security Strategy. My views on the shipbuilding industrial base in the United States are shaped by my work experiences and analyses, as well as by the observations and analyses

of the military and civilian students in the Shipbuilding Industry Study classes that I have worked with.

To support their studies, the students and faculty meet with senior government and shipbuilding industry executives as well as senior representatives of organizations associated with the industry such as suppliers, associations, unions, classification societies and ship owners and operators. We also visit numerous shipyards and associated industrial facilities in the United States and overseas. This has given me an opportunity to study the industry and observe trends that have developed over time and shipbuilding processes practiced throughout the world.

The views, opinions and recommendations that I will express in this testimony are my personal views, opinions and recommendations and do not necessarily reflect those of my students, the Industrial College of the Armed Forces, the National Defense University, the Department of Defense or any other person, organization or agency.

The infrastructure differences that my students and I have seen on our visits to various shipyards around the world. In particular, I will address the efficiencies of foreign shipyards in their physical laydown, automation of equipment, and control of secondary supply.

The most striking differences that I observe among shipyards are their physical size, use of automation and proximity to their supplier base. It is often a combination of these three elements that give the shipyards their competitive advantage in the global marketplace. World-class shipyards tend to optimize around high volume, low cost production processes. The Asian yards are often much larger compared to their European or US counterparts. They take advantage of their large footprint by setting up their material flow and work processes to optimize high-volume processing of a limited number of different ship types and configurations.

The early phases of production are highly automated. The massive steel plates are cut, shaped and framed almost entirely by robotic cutting and welding systems. The small modules formed through this automated process are combined to form larger building blocks that are then combined to form the complete ship. As the modules and blocks are completed, they are outfitted with their pipes, electrical and mechanical systems and often given their initial or even final coat of paint. In the larger yards, a higher percentage of this work is done indoors, in their production facility, allowing the work to be done more efficiently and therefore less expensively than work done outside at pier-side, in the dry dock or in the water.

The outfitting process tends to be very labor intensive throughout the world. In European yards that specialize in cruise ships, much of the outfitting is done in modules by outside venders. The passenger staterooms, for example, are often built in a specialized facility located in close proximity to the shipyard. They are delivered to the yard as a single module and placed in the ship. Their electrical, lighting, plumbing and heating systems are completely fabricated as part of the module and simply connected to the ship's main systems when the module is installed. The close proximity of the vendors and the relative stability of their order book enable the vendors to operate at

high efficiency and support the shipyard's ability to control the associated module costs.

The differences in complexity of warships which are procured at low rates, and commercial vessels with standard, and less complex designs.

Production processes and practices that make commercial shipbuilding extremely efficient are not always the best choices for the construction of warships. In both Asian and European yards, the most highly automated ship construction techniques are applied at the earlier stages of construction, especially the steel construction. There is considerably less automation during the outfitting stages.

Many of the efficiencies during this stage of construction come from the ability to work indoors - a direct result of the facility layout and investment priorities, the ability to take advantage of steep learning curves - a result of the large number of similar ships they construct in relatively short time spans, and the use of strategic outsourcing - a result of the vendor base of specialists that has developed in close proximity to the yards. Technical oversight for the construction of cargo ships is predominantly performed by the classifications societies and the ships are built to the societies' engineering standards.

Asian yards are extremely efficient at building cargo carrying ships. Their ships can carry liquid, bulk or containerized cargo. The owners and operators of these ships are interested in operating at the lowest possible cost per ton of cargo per mile. The key feature of these ships is lots of open space to store and transport the cargo. The ship designs are quite mature and once a contract is signed for the construction and purchase of a ship, the owners rarely request engineering or design changes to the original order. The electrical, mechanical, communications and propulsion systems tend to make up a small proportion of the overall ship. The outfitting stage of construction is therefore less complex than for passenger ships or warships.

European yards are extremely efficient at building passenger ships. Virtually all of the current cruise ships under construction are being built in Europe. The yards in Europe are typically smaller than the Asian yards and their use of automation is a bit lower. The owners of these ships are primarily concerned with providing their customers with the best vacation experience possible. Their "guests" assume that the ride will be smooth and safe. The cruise liners differentiate themselves by providing distinctive visual and life-style experiences and by the services they offer. The visual and sensory impact the guests feel when they first board the ship, while crucial to a cruise ship, is rarely considered during the design of a cargo or war ship. As a result, the ship owner takes a considerable interest in the design and fabrication of the public spaces. Like the cargo ships, the technical oversight of the hull, electrical and mechanical systems is typically performed by classifications societies and the ships are built to the societies' engineering standards. The design of the ship and the fabrication processes reflect this. While each new ship may have unique leading edge interior design features, contributing to commercial differentiation among cruise ships, the basic hulls and

machinery systems tend to be mature technologies. And like cargo ships, once the purchase contracts are signed, the owners rarely request engineering or design changes.

War ships present a higher level of complexity than even the most elaborate commercial cruise or cargo ships. Tightly-integrated leading-edge weapons, sensors, fire control, and communications systems coupled with ship, crew and system survivability as well as ship maneuverability, sea keeping and station-keeping provide the strategic advantage to war ships operating in the battle space. The necessity to simultaneously integrate and balance all of these attributes contributes to the inefficiencies associated with the construction of war ships.

Just as the owners of cruise ships focus their management oversight on the design and construction of the public spaces on their ships to ensure that their "guests" receive the best possible vacation experience, the owners of war ships, in this case the Navy, focus their attention on the of the myriad of inseparably linked attributes just discussed. In addition, many of systems chosen for inclusion in the design are based on the latest leading-edge technology available, and may have never been used in these applications before. Unlike its commercial cousins whose competitive advantage is derived from its cargo-carrying capacity or its creature-comfort esthetics, it is precisely the marginal performance of the ship's hull, mechanical and electrical systems coupled with the tight coupling of the weapons and sensor systems that provide war ships with their competitive advantage.

Managing the design and fabrication of the large number of HIGHLY-DEPENDENT variables is the complexity that makes war ships so much more difficult to construct than even the most complex commercial ships. In addition, since the performance of each sub-element of the ship contributes directly to its competitive advantage in the battle space, the owner often desires to make engineering and system changes throughout the design and construction process. All of these sub-elements are so closely coupled and even minor changes in one attribute, may have significant, unknowable and unpredictable effects on the overall ship construction process, schedule and cost.

The value in the government investing in shipyard infrastructure to increase producability and decrease man-hours.

If properly focused and managed, there is great value in the government investing in shipyard infrastructure to increase producability and decrease the number of man-hours associated with the construction of the US Navy's war ships. In fact, my students noted in their paper last year that: "… the USG could fully fund the Title XI loan guarantee program, increase tax incentives, accelerate depreciation allowances for capital investments, expand the capital expenditure (CAPEX) program, which reimburses firms for expenditures on capital improvements that reduce costs, and increase grants and loans." A ship that is easier to produce and requires less man-hours of labor should be less expensive to purchase. The important issue here is that even if the ship is less expensive to purchase, it is more important that the ship retain its fighting advantage in the battle space and that it remains affordable to operate over its life cycle.

What are the best investments the Government can take to help improve efficiency?

As I discussed previously, war ships are built specifically to ensure competitive advantage in the battle space. Throughout the history of Naval shipbuilding, war ships have almost always been modified during their construction phase to enhance their producibility or to take advantage of a newly introduced technology, fabrication technique or design feature that can enhance their competitive advantage when delivered to the fleet. The battle space is constantly evolving and if ships under construction are not able to keep up with real-world requirements, they may lose their competitive edge before they are even placed into action and rendered worthless at the pier.

It is unreasonable to expect or desire that the Navy will ever procure a cluster of ships that are absolutely identical and for which no changes are allowed during the construction process. It would, therefore, seem to make sense to promote a design and construction process that acknowledges that changes will be made and efficiently accommodates them.

As the best and newest shipyards in the world continue to become more and more efficient at mass-producing high-volume, low-cost standard design ships, US shipbuilders have an opportunity to set the world standard on mass-customization of low-volume, "reasonable"-cost, flexible-design ships. Although the combination of low-volume, reasonable-cost and flexible-design would have been impossible to achieve even a decade ago, in today's modern networked world, the theories, tools and processes exist to make this a reality.

The shipyards cannot do this alone. The infrastructure investments necessary to achieve this goal can be justified across the Navy's shipbuilding enterprise, but may not be justified across any single ship contract or single yard's expected order book.

I look at the ship design and construction process in the context of Harvard Business School Professor Clayton Christenson's "Value Chain Evolution Theory." In his book, Seeing What's Next, Professor Christenson writes:

> "Before a product or service is good enough to meet mainstream customer needs, integrated firms that control the entire production and delivery process are best suited to coordinate the complexities developers will confront when trying to improve the product." "Stitching together a system with a series of partner companies is next to impossible when there are complex interactions across the boundaries of what the firm provides. Management is the only force capable of coordinating these interdependent variables." "In an effort to develop products or services more quickly, companies tend to standardize interfaces between various parts of the product or service. These standards eventually morph into industry-wide standards and allow companies to get to market more quickly because they can replace individual components without redesigning an entire product. Modularity enables the creation of specialist firms capable of developing products that fit these interfaces. This

change allows previously integrated firms to outsource pieces of their product to vendors that meet their specifications."

Today, we use "integrated firms that control the entire production and delivery process" precisely because they: "are best suited to coordinate the complexities developers will confront." The environment is changing and we have an opportunity to take advantage of this.

European shipyards are following this theory when they set the interface standards for the passenger staterooms and outsource the complete fabrication of these modules. The Navy is following this theory when it asks Electric Boat and Newport News Shipbuilders to outsource parts of each ship to each other. Both Aker Shipyard and NASSCO are proposing to follow this theory when they outsource whole modules of their ships to other yards. And, Northrop Grumman Ship Systems and Bath Iron Works are following this theory when BIW became a supplier to help overcome a delay caused by Hurricane Katrina.

The government should focus its investment in infrastructure that supports this type of transformation. The most critical infrastructure elements are tools that allow digital design data to be transmitted directly to automated fabrication equipment and robots on the shop floor. Acquiring and integrating the most current automated fabrication equipment and robots is also required. These kinds of investments can never be justified across a single ship class, but they can easily be justified across the entire Navy Shipbuilding Enterprise.

Is it in the economic best interest of the shipyards to become efficient without some form of government subsidy?

It is always in the best interest of a company to become efficient at its core capabilities. US shipyards are constantly striving to achieve this. My students noted in their report last spring that: "During visits to the U.S. shipyards, we found that all of them have invested in capital improvements and have plans to continue doing so. We also noted that many of the yards are actively working to improve processes and have instituted Lean Six Sigma programs." The key issue for industry is to balance their investment portfolio with their expected business base and their return on investment. Since the return on investment cannot always be justified on the basis of highly predictable future orders, shipyards are limited in the scope of the the investments they make. My students also noted that: "Despite these gains, a company representative familiar with the techniques employed by US and European shipyards advised us that the US shipbuilding industry is currently about fifteen years behind in implementing changes that would enhance productivity."

To improve this situation, targeted government support is required. The concept of mass-customization was introduced in 1987 by Mr. Stanly Davis in his book: Future Perfect, and discussed extensively by Joseph Pine and Stanley Davis in their book: Mass Customization, published in 1993. In the decades since this concept was introduced the world has changed considerably. What was unimaginable at the time of its introduction is now commonplace in industry.

Where can efficiencies be found in the construction process?

While my class was visiting shipyards last spring another one of our classes was analyzing the state of manufacturing around the world. In their report, they wrote: "To ensure that DOD leverages the private sector's investment in manufacturing technology, policymakers should apply "Digital Thread" technologies to all DOD system acquisition programs which link all aspects of the system together from Computer Aided Design (CAD) to Computer Aided Manufacturing (CAM) to operations support and logistics. This will have the effect of enhancing traceability and transparency throughout the system and will enable designs that are more robust, more cost effective production, and system-wide integrated product support initiatives."

This is precisely the path I am suggesting we peruse.

When I spoke before this sub-committee last year, in response to the questions asked of me, I suggested that collectively we should: 1. Fund the CNO's Long-Range Plan for Construction of Naval Vessels in a stable fashion, 2. Support the U.S. Maritime Administration's Short-Sea Shipping Initiative and 3. Fund their Federal Ship Financing programs. I continue to stand by these suggestions and am delighted to see that there has been great progress in stabilizing the Navy's shipbuilding plan. If we also invest in infrastructure that enables our shipyards to set the world standard for mass-customization in shipbuilding our Navy will continue to operate the finest, most advanced ships the world has ever seen. Our sailors deserve no less.

Chairman Taylor, Representative Bartlett, distinguished members of the subcommittee, thank you for the opportunity to appear before you to discuss my views on the current state of the shipbuilding industrial infrastructure in the United States and how it supports the National Defense Strategy. I look forward to your questions.

QUESTIONS AND ANSWERS SUBMITTED FOR THE RECORD

MARCH 20, 2007

QUESTIONS SUBMITTED BY MR. TAYLOR

Mr. TAYLOR. Is there any way to increase the amount of commerical work ongoing at US shipyards? To what extent is it the Navy's responsibility to facilitize the shipyards to compete for commerical work?

Admiral SULLIVAN. While the major shipyards are not competitive in the commercial arena, the second tier yards are active in commercial work. We currently have a number of incentives available to all U.S. shipyards to improve their ability to compete for commercial work. These include the Title XI Ship Loan Guarantee program, contract incentives, and Shipbuilding Capability Preservation Agreements. All of these programs work to enhance the shipyard's ability to compete for commercial work.

While the Navy would welcome increased commercial work at the shipyards, as it would lower the costs to the Navy, the Navy has no control over the shipyard's business strategies. Recent forays into commercial work by the major U.S. Shipyards have proven unsuccessful, as the skill sets and equipment required on military vessels tends to be different than those required on commercial vessels.

Mr. TAYLOR. Foreign commercial yards are reportedly more efficient than US yards. Are foreign military vessels constructed at these commercial yards? If not, how do foreign military yards compare to US yards in terms of competitiveness? How do these yards maintain their competitive edge?

Admiral SULLIVAN. In January 2006, the Secretary of Defense submitted an independent study to assess the overall effectiveness of the Navy ship construction program to the Congressional Defense Committees. An independent shipbuilding consultancy firm, First Marine International (FMI), completed the assessment and wrote a report, entitled *First Marine International findings for the global shipbuilding industrial base benchmarking study.*

In general, foreign yards are more efficient than the U.S. yards, however U.S. trends have improved in key areas. Three major findings of FMI's report were:

1. The six major private U.S. shipyards have made progress in improving shipbuilding best practices since a previous round of benchmarking was conducted in 1999. However, more emphasis should be placed on production design and engineering, quality control, and information technology (enterprise resource planning systems).
2. U.S. Naval vessels appear to have more work content than comparable international vessels.
3. In addition to the overall benchmarking assessment, FMI also produced company proprietary benchmarking results for each individual shipyard. These individual results offered shipyard-specific recommendations of discrete actions for each U.S. shipyard. The investment requirements necessary to implement these plant improvements are supportable based on U.S. shipbuilder profit margins. It was the Secretary of Defense's expectation that the U.S. shipyards will use their own resources if they choose to pursue these improvements.

In some foreign shipyards, both commercial and military vessels are constructed. This military construction's often segregated from the commercial construction. These foreign yards are roughly equivalent to U.S. shipyards in terms of performance on their military vessels. For instance, at the Yokohama yard, IHI, we found that their surface combatant was comparable pricewise to a smaller version of a DDG–51, in a follow-ship kind of configuration. If you were to scale their combatant, the cost would be about the same. Hyundai shows a similar result.

Foreign commercial yards maintain their competitive edge by:

1. Receiving governmental subsidies
2. Higher commercial ship production rates

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