Naval War College Review

Volume 47
Number 3 *Summer*

Article 5

1994

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IN 1919, TWO THINGS WERE CLEAR about the entry of the United States into World War I: first, that the contribution of the U.S. to Allied victory had been crucial; second, that the performance of American industry had left a great deal to be desired. The United States had contributed money, food, ammunition, ships, and manpower. It had not, however, contributed aircraft, weapons, and tanks at the speed which the allied powers had expected.

To remedy the problems of planning and coordination that had plagued weapons procurement by the services during World War I, Congress passed the National Defense Act of 1920. From that time until the passage of the First War Powers Act on 18 December 1941, the legislative and executive branches experimented with what today are termed "reconstitution" and "surge." They did so in an environment much like our own: government spending was very limited, popular support for a large military budget was even more limited, and the future of the economy was uncertain.

This article is an effort to look into the future by considering the past. What are "reconstitution," "surge," and "mobilization"? How are they connected to each other? The article tries to answer these questions by exploring the experience of the U.S. Navy in the years after World War I. At the time, the entire effort was considered "mobilization" planning (mobilization itself would actually begin on 18 December 1941). Though they did not then use the words "reconstitution" and "surge," the War and Navy departments did have policies analogous to those modern concepts for preparing for the next war; the way they were implemented can tell us something about what can and should be done to make them a success the next time around.

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Reconstitution

Reconstitution comprises the strategy of, and the planning for, reestablishing and refinancing forces of a size sufficient to deter or win a major war. It is a foundation, or a structure, that must exist beforehand if any "surge" in defense production is to occur. As a strategy, reconstitution rests on the following propositions: first, that planners can accurately chart the processes required to bring together trained personnel and their equipment in sufficient numbers; second, that the government has the necessary powers to initiate and sustain those processes; and, third, that American society has the basic resources (human, financial, and material) required to turn plans for reconstitution into reality.

In 1920, the third proposition was taken for granted. The National Defense Act of that year assigned the responsibility for war mobilization planning to the assistant secretary of war. The Act also authorized the Army and Navy to set up joint boards to coordinate their plans for war production. To back up planning with action, the Act allowed the service secretaries to place "educational orders"—limited production contracts intended to promote industrial research and development and to "train" industry in producing items which met military specifications.[1] Such orders were intended to lay the foundation for future mobilization. But the National Defense Act of 1920 did nothing to rescue the ship and aircraft industries, whose business base collapsed at the end of World War I. Of the seven manufacturers selling airplanes to the Navy in 1918, for example, only two were still in business in 1921.[2] Two major shipbuilders, Bath Iron Works and Cramp, went under during the middle and late 1920s, and their competitors survived by building railway equipment, heavy industrial machinery, and hydroelectric turbines.[3] Production for World War I had flooded the postwar market with ships and airplanes, depressing the commercial demand for ships (the commercial airplane market did not exist). It was not clear how best to offset the steep decline in the government's demand for ships and aircraft, but it was clear that without *some* government action, mobilization for a future world war would be seriously jeopardized.

Congress, in response, first resorted to subsidies for mail delivery. The Air Mail Act of 1925 shifted the delivery of air mail from the Post Office to private carriers operating under contract to the government. Complementing this law was the Air Commerce Act of 1926, which authorized the Department of Commerce to establish and regulate radio beacons for air navigation and radio stations at airfields.[4] The success of the Air Mail Act of 1925 led Congress to pass the Merchant Marine Act of 1928, which allowed commercial shippers to bid for overseas mail deliveries and tap a Commerce Department ship construction loan fund.

But it was not enough just to encourage and subsidize commercial production and operation of ships and aircraft. The services, because they lacked strong research and development organizations, relied on industry for those functions. If reconstitution (as we would call it today) was to succeed, the shipbuilding and aircraft industries had to be able to advance their respective technologies in ways that supported the Army and Navy. There had to be means of guaranteeing that industry would do the necessary research and development.

For aircraft, the solution was the Air Corps Act of 1926, which authorized both the Army and the Navy to procure and maintain large numbers (1,800 for the Army, 1,000 for the Navy) of up-to-date aircraft.[5] Both services were given five years to replace gradually their aging airframes with newer models. The Act also permitted the service secretaries to stage design competitions and to negotiate contracts for experimental items. For the first time, the service secretaries could award contracts to the "lowest responsible bidder," not just to the lowest *qualified* bidder.

Airplane developers had avoided design competitions on the grounds that if a firm invested its own funds to design a better airplane, the government would then take that design and initiate a separate competition to produce it—which a competing firm specializing in production would probably win.[6] The Air Corps Act of 1926 was passed in order to make aircraft engineering innovation a profitable, or at least viable, enterprise.[7] The Act allowed the Army and Navy to reward manufacturers for what today is called "internal research and development."

Innovation in warship construction was driven by advances in the design and construction of merchant ships, especially in the field of steam engineering. Commercial ship designs, for example, pioneered the use of high-pressure, high-temperature steam to boost engine output while reducing engine weight; Navy design practice followed accordingly. The heavy cruiser *Indianapolis*, laid down in 1930, was given boilers that produced steam at a pressure of 310 pounds and at 150 degrees Fahrenheit of superheat. The destroyer *Somers*, begun five years later, carried boilers that worked at twice that pressure and six times the steam temperature.[8]

Navy warships in the 1930s were designed under tonnage constraints imposed by international agreements. Designers consequently tried to reduce machinery weight in order to gain a margin for other weight-consuming items, such as ammunition and armor protection.[9] Indeed, the Navy's Bureau of Engineering tried throughout the 1930s to benefit from commercial industry's work on lighter, more efficient steam plants.[10] The Bureau had already acted to promote the design of lighter, more powerful diesel engines for submarines.[11] Both efforts were taken in parallel with those of industry; both the Navy and commercial

shippers were interested in promoting schemes to keep machinery weight and maintenance cost low while increasing performance.

These acts of reconstitution were just in time. The services were beginning to link their war planning with their effort to plan industrial mobilization. In 1930, for example, the Army and Navy Munitions Board drew up its first Industrial Mobilization Plan. The Plan was based on joint war planning for a campaign against Japan, and it was the first time the Army and Navy had tried to anticipate and plan for the kinds of production and supply problems that had hindered them during World War I.[12] The services also recognized that something had to be done to make sure that crucial defense industries survived the depression with enough productive capacity to fulfill the goals of service mobilization planners.

Thanks to the Merchant Marine Act of 1928, Navy warship authorizations, and the desire of shippers to replace their aging fleets, major U.S. shipbuilders "entered the depression with firm work commitments for at least three years."[13]

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The aircraft industry, though small, was also doing well, partly because of the Air Corps Act and partly because air transportation was about to become profitable. The key year for the airlines was 1932, when Douglas Aircraft produced the aerodynamically sophisticated and money-making DC-1 and DC-2. By 1935, when Douglas produced the first DC-3s, the firm had a large backlog of orders from the growing international airline industry.

But there was still more to reconstitution. In 1927, for example, the Navy General Inspector tried to consolidate all the various Navy Department inspectors who monitored the production for the Navy's bureaus of Engineering (which designed and bought power plants), Construction and Repair (which designed and bought ships), Ordnance (charged with producing weapons), and Aeronautics (which acquired aircraft).[14] The General Inspector's goal was to place the inspectors from the different bureaus under one management at each plant or shipyard. As it was, the different inspectors reported separately to their individual bureaus; there was little coordination at the sites where the items they purchased were produced. Though not entirely successful, this reform was the basis for Navy product-quality inspections in World War II.

Similarly, Rear Admiral H.G. Bowen, as Assistant Chief, and then Chief, of the Bureau of Engineering, tried to streamline and reform the management of shipbuilding and its oversight within the Navy Department. As Bowen observed in his memoirs, "many of the shipbuilders, perhaps all, knew very little about

accounting job order costs and estimating, and they knew nothing at all about budgeting funds, particularly on new construction."[15] To force shipbuilders to modernize their planning, scheduling, and cost accounting practices, Bowen in 1933 established a Scheduling, Estimating, and Progress Office within the Bureau of Engineering.[16]

That same year, the chiefs of the Bureau of Engineering and the Bureau of Construction and Repair chose the firm of Gibbs and Cox to produce standardized, detailed designs for Navy ships for use by commercial yards. The three largest yards—Newport News, Bethlehem, and New York Shipbuilding—could develop detailed designs and even manufacture their own power plants. The Navy, however, wanted to keep as many yards active as possible; Navy leaders did not want to see the three major yards drive their smaller competitors out of business. Gibbs and Cox, accordingly, was used as a kind of equalizer, providing a service that the smaller shipyards could not afford on their own.

Rear Admiral Bowen later recalled that the Navy understood at the time that the process of manufacturing ships had fundamentally changed: "The industry did not appreciate the fact that the old ship-and-engine builder was gone and that shipyards must become assembly yards."[17] That is, shipbuilders, *during an emergency*, would not build ships plate by plate from the keel up; instead, they would simply assemble subsystems already fabricated outside their building ways or even outside their yards. Put another way, ship construction had to move in the direction of assembly-line manufacturing. The major shipbuilders opposed this change, because, if implemented, it would make them dependent upon other industries. Indeed, it would make them just one link of a larger, longer industrial chain, and they would cease to dominate the shipbuilding process.[18]

Shipbuilding and aircraft manufacturing in the early 1930s were alike in this way: neither was an assembly-line process. Neither industry had abandoned craft processes in favor of mass production. Both produced relatively small numbers of finished items. In addition, the owners and managers of the larger firms in both industries feared the mass production expertise of the auto industry. As a result, neither the shipbuilders nor the aircraft manufacturers wanted to adopt assembly-line techniques.

During the depression, however, both Navy and industry leaders focused on keeping basic production capability strong. The trick to shoring up the shipbuilding industry was to define shipbuilding as a form of public works, thereby making the shipbuilding industry eligible for direct government subsidies. This is precisely what the National Industrial Recovery Act (NIRA), passed in the spring of 1933, did. By June of that year, the Navy was given funds under the Act for the construction of thirty-two ships. Invitations for bids went out almost immediately; the bids were submitted at the end of July, and contracts were awarded in August.[19] Unfortunately, the NIRA authorizations were only

temporary. To reconstitute the shipbuilding industry, the Navy needed steady, predictable construction.

It got that guarantee in March 1934 with the passage of the Naval Parity Act, popularly known as the Vinson-Trammell Act. The law authorized the construction of one hundred warships and over a thousand naval aircraft over a period of five years.[20] It also set a ceiling of 10 percent on industry profits from contracts let under the law.[21] The profit ceiling was written into the law to placate critics of military spending; the critics were expected to use the Senate Munitions Investigating Committee, which met first in April 1934, as a platform to assail military expenditures, so it was politically essential that Vinson-Trammell not appear to be an industry giveaway.

Congress complemented Vinson-Trammell by passing the Merchant Marine Act in June 1936. The Act eliminated the Shipping Board in the Commerce Department and created in its place an independent agency, the Maritime Commission. It also eliminated federal subsidies for mail delivery; the new Maritime Commission was authorized instead to pay shipbuilders and ship operators part or all of the difference between their actual costs of business and the costs incurred by their foreign competitors. The Maritime Commission itself was staffed largely by former Navy civilian employees; its first chief was the former head of the Navy's Bureau of Construction and Repair. In addition, all contract plans and specifications for ships being built under subsidy were cleared first by the Navy Department.[22]

With the implementation of Vinson-Trammell and the Merchant Marine Act, reconstitution *of production* was nearly complete. Shipbuilding, at least, was secure. The major and minor yards with experience building Navy ships were awarded contracts; even Bath Iron Works, reorganized as a small shipyard after 1927, was producing destroyers. Builders specializing in commercial designs were also working on ships, many of which would become naval auxiliaries, through Maritime Commission subsidies. In January 1938, for example, Standard Oil of New Jersey and the Maritime Commission agreed to finance construction of twelve high-speed tankers by four shipyards. All twelve of these ships were purchased by the Navy when war threatened.[23]

Naval aviation and ship reconstitution in the 1920s and 30s was not a complete success. A major weakness was the nature of government contracting, which emphasized awarding contracts on the basis of lowest price. Ships were acquired through a competitive, two-step, sealed-bidding process. First, the Navy advertised for bids; when the bids came in, the bidders were screened for technical capability (to determine whether they could in fact build the ship to Navy standards). The survivors of that screening were screened for price, and contracts were awarded to the low bidder or bidders. Vinson-Trammell's blanket

authorization allowed the Navy to go to Congress every year to request appropriations for numbers of ships. Because the low bidders did not have the capacity to build more than a few ships, there would be ships, especially destroyers, "left over" for the smaller yards. In effect, the two-step, sealed-bid process did not keep the Navy from supporting a rather broad base of shipbuilders, despite the law's emphasis on awarding contracts to the lowest bidder.

Aircraft were a different story. Though airplane makers saw the military aircraft market as lucrative, they had trouble breaking in. As Army Air Corps historian I.B. Holley, Jr., learned, "the seemingly attractive military market was confined more or less to a dozen manufacturers specializing in military types, and even within this group, four firms received the bulk of the business. . . ."[24] The reason was simple: the Army and Navy demanded small lots of high-performance aircraft that airplane builders could not produce without advanced research and development. Because so few manufacturers could finance their own research, the actual field of competition was narrow. Acceptable in peacetime, this situation posed a serious risk: that the aircraft industry would not be able to produce sufficient numbers of aircraft to meet wartime needs. In effect, the aircraft producers who wanted to get military contracts specialized in *design* engineering, not production engineering.

Surge

Surge is both quantitatively and qualitatively different than reconstitution. It means not only to produce more but also to produce in such a way that innovations can move quickly from the laboratory to the battlefield. In this case, the surge in production came in the last years before the U.S. entered World War II. Navy ship and aircraft production, for example, began to surge in May 1938, when Congress passed the Naval Expansion Act.[25] The Act authorized additional carriers, battleships, and cruisers plus an increase in the number of "useful" Navy aircraft to 3,000. In the fall of 1939, Congress dropped its legal embargo on dealing with belligerents and authorized "cash and carry" sales to the nations fighting World War II. The change in the law promoted a rush by the British and French to buy U.S.-built aircraft and merchant ships.

Demand was clearly moving up. Increased demand, however, did not guarantee that U.S. research and development efforts would be tied closely to the industries that were increasing their output of war materiel. Indeed, the major reason why U.S. aircraft producers had not contributed substantially to Allied aircraft production during World War I was that the producers could never anticipate what frontline flying units needed. Instead, U.S. producers were always behind, always disrupting their production schedules and processes in vain efforts to catch up.[26]

The first step in fixing such problems was to organize the executive branch of government. In the summer of 1939, President Franklin Roosevelt organized what amounted to a national command and mobilization staff. He placed under his direct control the Army Chief of Staff, the Chief of Naval Operations, the Army-Navy Munitions Board, the Aeronautical Board (which linked the services and the civilian National Advisory Committee on Aeronautics), and the Joint Economy Board (a forum where the services met with the staffs of the secretaries of the Treasury and Commerce). In September, Congress passed the Reorganization Act of 1939, establishing the Executive Office of the President and giving the president the authority to create agencies vital to the direction of the nation's defense. In June 1940, Roosevelt used this grant of authority to create the National Defense Research Committee, a top-level advisory board to help the president set national research and development priorities.

It was just a little too late. In February 1939, the Navy's surface ships performed miserably in antiaircraft exercises against remotely piloted drone targets. As the Commander in Chief, U.S. Fleet, admitted, "the accepted procedures and technique are not uniformly capable of being extended successfully to firings on a maneuvering target."[27] The tests conducted with the drones prompted a wholesale revision of the Navy's program for antiaircraft weapons research and development. The change would lead eventually, in 1942, to the production of proximity fuzes for antiaircraft shells. But the tests also revealed that the Navy's close-range antiaircraft defenses were alarmingly weak and that the research that had been done in this area in the 1930s had been only a partial success. In this instance, the surge period—the summer of 1938 through the summer of 1941—was not used effectively to link laboratory work with production.

It *was* long enough for the Maritime Commission to develop in 1938 a plan to expand the commercial shipbuilding industry. The Commission understood that the Navy would claim much of the existing shipbuilding capacity once a surge of output was authorized, so it planned for, first, an expansion of capacity and, second, the standardization of commercial transport designs. When Congress voted again to expand the Navy in June and July 1940, the Maritime Commission was ready.[28] By the end of the year, it nearly tripled the number of yards building standard merchant ship designs.[29] Construction of the famous Liberty ships began in January 1941.

However, as James Forrestal, appointed Under Secretary of the Navy in the summer of 1940, discovered, the service's secretariat did not coordinate or control the process of materiel production, except in an artificial, formal sense.[30] He also discovered that there was no structured procedure for coordinating Navy aircraft procurement with the Army and that contracting procedures were not standardized across the Navy's bureaus.[31] There were not enough trained

contracting personnel to draw up the number of contracts already agreed to. Finally, Forrestal's office, responsible for managing war production, did not even have accurate information on progress (or lack thereof) on existing contracts.[32] The Navy acquisition executive was not able to handle surge, let alone wartime mobilization.

The primary reason it was not ready was that there was no national industrial mobilization board that could allocate resources (labor, capital, and raw materials) and finished products (such as ships and aircraft) among all the claimants. Such a board would have forced the Navy Department to put its own house in order. In August 1939, President Roosevelt tried to remedy this problem by creating the War Resources Board. It lasted six weeks. Thus began a process of trial and error in which the president looked for a politically acceptable and yet workable body for national economic and military coordination.

While the president searched, existing organizations struggled in the absence of clear national policy. In September 1940, for example, the president created the Army-Navy-British Purchasing Commission to coordinate the distribution of aircraft among the three major users.[33] The Commission was supposed to work under the direction of the National Defense Advisory Council, created as a successor to the ill-fated War Resources Board. While the Council struggled (unsuccessfully, as it turned out) to set national priorities, the Purchasing Commission began a process of negotiating the allocation of war materiel (aircraft and aircraft engines) among its members.

The evidence suggests that such lower-level organizations were able to work out a number of issues even though the president could not find a means to translate his strategy into clear directives for the economy until the spring of 1943.[34] One reason for this success amidst confusion was the ability and willingness of Army and Navy aviation leaders to broker their differences.[35] A second reason was their willingness to accept proven and prototype aircraft designs; by not emphasizing research and development, they made it possible for aircraft production to expand rapidly. In May 1941, for example, the Ford Motor Company began planning to produce B-24 four-engine bombers at the rate of six hundred per month.[36] The reverse, and negative, side of this coin was that design changes, the bane of manufacturing engineers and managers, became the norm for military aircraft in wartime. Unfortunately, the services did not master until 1944 what today we call block modifications; accordingly, in the first two years of the war there was great tension between the need for large numbers of aircraft and the equally compelling need for thoroughly modern aircraft.[37]

Measured in terms of numbers, the surge in industrial production was a success. Because of the depression, there was unused capacity in U.S. industry

generally, and the automobile industry in particular stood ready (as it had in World War I) to crank out airplanes in great numbers. The effort to reconstitute the industrial base had worked. The problem was one of making sure that the great American industrial engine produced *what* was needed, in the right numbers. That problem was not solved during the surge period.[38]

Mobilization—the Payoff

After Japan attacked Pearl Harbor, all prewar constraints on planning and contracting were removed. The result was a leap in production that built on, yet dwarfed, the totals that had been produced as the economy surged in the previous several years. Yet that great leap would not have been possible without the previous years of work on what amounted to reconstitution of the military manufacturing base. The American World War II mobilization experience is a familiar story and is of interest here largely in what it reveals about how well the earlier efforts toward what we now call reconstitution and surge had paved the way for it.

In December 1940, for example, U.S. commercial shipyards planned to deliver about 700,000 cargo-tons of ships in 1942. In March 1941, the Maritime Commission changed that figure to just over three million tons. On 1 December 1941, the figure was increased yet again, to six million tons.[39] In World War I, production of merchant shipping peaked only after the war had ended; in World War II, it peaked in 1943, soon after the hardest fighting in the battle against Germany's submarines.[40] What this suggests is that reconstitution, as a deliberate policy, had worked, at least in the critical area of merchant shipping.

Aircraft production was another matter. It did not peak until 1944 and did not build up at the same rate as merchant ship production.[41] The reason was simple: "Low-priced airplanes waited upon the introduction of production techniques in the industry, but high-volume production could be justified only by a mass market, which waited upon low-priced airplanes."[42] In addition, no one figured out before the war how to keep the assembly lines full while still applying needed modifications to aircraft in production. There was *no civilian market* that stimulated the industry to learn how to link production and modification. That made reconstitution harder. The technological jump from a high-performance aircraft of 1941 to its 1944 equivalent was much greater than the jump from the Liberty ship to the Victory ship. Moreover, the automobile manufacturers, though pledged and ready to produce large numbers of aircraft, found that not all their assembly line techniques could be transferred quickly to the production of airplanes. They still had "learning curves" to master before they could maximize output.

The surface Navy would face a different problem, though its nature would not be apparent until after the war. To win the war, the nation had to build a huge fleet; but the war inevitably brought major changes in military technology that would make obsolete the very fleet the Navy had built to win it. The combat navy built before and during the war would not be well suited to the postwar world. Destroyers would be too small to mount the sensors and weapons needed to track and destroy submarines having high underwater speed; battleships would simply not be needed, except for shore bombardment; the main carrier design of the war, the *Essex* class, would not be suited to handle jet aircraft. The huge navy of 1945 would find itself not well adapted to the kinds of conflict which wartime research and development projects had made possible.

The Navy's bureaus concerned with shipbuilding and armament were not able to forecast the success of new systems such as missiles. In the 1930s, for example, the Bureau of Ordnance developed a new torpedo, two major-caliber anti-surface fire control systems and a dual-purpose (i.e., antiair and anti-surface) one, servo mechanisms to link fire control directors to the guns they controlled, five sizes of heavy guns, and radar and sonar. By war's end, almost all were obsolete, had improved beyond recognition, or had been overtaken by different technologies. The same situation prevailed in U.S. air forces. Jet turbine technology and supersonic flight were clearly the wave of the future, but only Germany and Britain effectively exploited these new technologies during the war itself.

Reconstitution policies developed after World War I aimed to forestall the problems which had hindered military production during that conflict. The focus was on hitting the peak of production at the crucial juncture of the war. That was relatively easy to do in merchant ship construction, but the idea itself made little sense in fighter aircraft design. Masses of obsolete aircraft would simply have been plentiful, easy targets. In warship development, hitting simultaneously the peaks of both quantity and quality was almost impossible, given the years which came between the creation of a design and its use in service.

In short, the efforts at reconstitution in the years between World Wars I and II were incomplete. Several illustrations make this point.

Contracting law, for instance, and as described, did not adjust until just before World War II; as a result, when production surge began there were too few trained government contracting officers. Moreover, because experienced contracting officers were wedded to peacetime routines, they were unprepared for the flood of Navy contracts that followed the expansion legislation passed in the summer of 1940. They also lacked experience in negotiating with industry, because prewar policy had stressed sealed-bid competitions.

Prewar mobilization plans developed by the services were also inadequate. There were several reasons for this failing. The first was that military planners did not anticipate how immense the U.S. production effort could or would become. The second was that no one had quite figured out how to direct a national economy while still preserving the market structure that made that economy so productive. The U.S. economy could not be managed in detail from Washington—but it had to be directed if modernization were to succeed.

The solution to this balancing problem was the Controlled Materials Plan, developed by Ferdinand Eberstadt, an assistant to Under Secretary of the Navy James Forrestal. In brief, the Plan let the Director of Economic Stabilization control the allocation of steel, aluminum, and copper among the industries working to reach their production targets. Other materials were not directly affected, though their prices and quantities available varied with the changes in the amounts and prices of steel, aluminum, and copper. This plan had not existed before the war, nor had it been tested in exercises or wargames of any sort.

Before World War II, efforts to prepare for mobilization defined the goal simply as increasing output. Little attention was paid to developing means of controlling inputs in order to regulate output or to creating institutions that could translate war policy into production quotas for all the vital war industries. Where output was the true measure, prewar efforts bore fruit; merchant ship production is the classic example. During the surge phase, however, when high output had to be coupled with modifications and effective research and development (in such areas as combat aircraft and warships), prewar plans were far less successful.

Reconstitution Is a Gamble

"Reconstitution" as such was not a deliberate policy before World War II. Mobilization planning was deliberate, but it was not a complete success. As a consequence of systemic inability *both* to reach high production quotas *and* incorporate new technology, after World War II both the Air Force and the Navy chose to focus their planning efforts on linking research and development (R&D) to production.

What the pre–World War II experience suggests, however, is that reconstitution has three parts: promoting preparations for production, linking R&D with production processes, and logistics. In the Navy, for example, the focus on producing numbers of ships and aircraft ignored the need to keep them effective in the western Pacific, where they were in contact with Japanese military power. In the 1930s, Navy leaders had chosen to ask Congress for appropriations for combat ships even though they knew that the need for auxiliaries (oilers, supply

ships, tenders, floating drydocks) was just as great. The fact that commercial designs for such vessels could be quickly adapted to military missions saved the Navy, as did the deliberate policy of the Maritime Commission of subsidizing ships that could be upgraded for military use. Navy leaders had counted on this ability to improvise; what they were not prepared for was the job of organizing a logistics pipeline to convey all this material—planes, supplies, and spare parts—from the U.S. to the western Pacific.[43]

Prewar planning also benefited from similarities between commercial and military technologies. Shipyards short of shipbuilding contracts, for example, did work for the railroads, and commercial airlines advanced aviation technology generally in their attempts to win passengers. Even the electronics industry was strengthened by having to serve a large commercial market. Only the U.S., for example, had an industry capable of producing high-quality magnetrons in quantity in the 1940s, and only the U.S. had produced frequency-modulation, or FM, radio transmitters and receivers in large numbers by 1940. Today's analogue is the personal computer, its peripheral equipment, and its software.

Lessons? There are many. One is the need to have sensible types of contracts and trained contracting officers. Another is the need for the military to keep track of industry; planners need to know what industry can do, where industry is, and where it is going. A third is a skilled manpower reserve. One of the most important actions the Navy took before World War II was to begin in earnest a reserve officers training program. This produced not only pilots and fleet officers but also numbers of managers—junior industry executives who shifted to the Navy when war threatened. Other managers were recruited through trade and technical associations.

A fourth lesson is the need for government to have experience with a funds-accounting process that will work when what matters is not dollars but things produced and forces fielded. Before World War II, for example, Navy accounting procedures were oriented toward reporting: Navy records were designed to show budget officials and members of Congress where funds had gone, not how well the dollars had been used. During World War II, Under Secretary Forrestal found that he had to prod his subordinates to develop a means of tracing the service's materiel requirements and consumption. As he well understood, tracking expenditures in a mobilized economy mattered less than tracking resources used, personnel committed, and materiel produced. But provision for such tracking should have been made years before the war, not after the fighting had begun.

In addition, reconstitution must generate familiarity. Service (and now Defense Department) officials must develop industry contacts. They must become familiar with what industry can do. The evidence suggests that the many

contacts between industry (shipbuilding and aircraft manufacturing) and the Navy before World War II paid handsome dividends once surge began.

But it is important to remember that many officials in both industry and government during World War II (Forrestal is a prime example) had also been active in junior roles during World War I. They shared an appreciation of the basic problems and a familiarity with industrial processes. This broad understanding was crucial to the success of wartime mobilization in the 1940s. It was one of the most important products of prewar Navy "reconstitution" efforts.

Two other lessons can be drawn from the Navy's experience before World War II. The first is that most of the Navy's warships that turned the tide of the war in the Coral Sea, at Midway, and in the Solomon Islands had been built *before* the surge period. They were part of a deterrent force that had to be able to win time if deterrence failed (as it did). Put another way, certain kinds and levels of military force must be maintained if the fruits of successful reconstitution are to be allowed to come into play and gain eventual victory.

Measured in terms of numbers, the surge in industrial production was a success. . . . The effort to reconstitute the industrial base had worked. The problem was one of making sure that the great American industrial engine produced what was needed, in the right numbers. That problem was not solved during the surge period."

It is not easy to do this. Before World War II, for example, aircraft carrier and battleship construction was sharply limited by international arms agreements. Carriers and battleships were the "silver bullets" of their day: there were not many of either type, and new units, especially new battleships, were seen as signals of political and military intent. Yet there was a conflict between the need to keep them modern and the long time it took to design and build them. The USS *Ranger* (CV 4), the first carrier planned as such, was designed before the Navy had had experience with the converted battlecruisers *Lexington* (CV 2) and *Saratoga* (CV 3). The characteristics of the *Yorktown* and *Enterprise*, successors to *Ranger*, were approved by the Secretary of the Navy two and a half years before the *Ranger* was commissioned. The weight of the air group of the *Wasp* (CV 7) doubled between the time that ship's construction plans were approved and when she was commissioned.[44] Advances in aircraft technology threatened to overwhelm the efforts of aircraft carrier designers to anticipate them.

The last lesson is that any policy of reconstitution will be incomplete unless it covers logistics as well as R&D and production. In 1934, for example, the Chief of Naval Operations eliminated the Material (i.e., logistics) Division from his office and replaced it with a maintenance division. The Material Division

was not reestablished until October 1941. Not until the eve of war did the Navy's senior uniformed mobilization planner have barely adequate staff support. The Navy's logistics triumphs (underway replenishment, mobile drydocks, and the Integrated Aeronautic Maintenance, Material, and Supply Program) were achieved *despite* a lack of prewar planning. Such an oversight would be catastrophic today.

The Navy today is in a much stronger position than it was, say, in 1938. Though contemporary technology is far more complex, the Navy is not short of personnel who can deal with it. The Navy has also mastered logistics and the ability to integrate research and development with engineering and production. The service has had over two generations of experience integrating the three "pillars" of reconstitution: production, logistics, and R&D. As an institution, the Navy is far better prepared to implement a program of reconstitution than it was after World War I, in spite of the advance of technology. Even the day-to-day relationships between government and industry have improved.

Can we, therefore, consider future reconstitution a problem solved in advance, with success guaranteed? Not at all. First, it can never be completely clear that reconstitution will work properly until it is tried. Remember that the people who managed it before World War II had lived through World War I; they knew that the next war would be something like the previous one, and they also knew that they had to plan for it. They carried forward their lessons from the past. Where they did not have clear precedents, as in the case of R&D management, they did not do very well.

Second, reconstitution works best where commercial markets independently sustain innovation and production. After World War I, for example, the United States Navy did not order a battleship between 1917 and 1937. In the intervening years, much of the skilled manpower and experience required to build such ships disappeared; there was no commercial industry to sustain it. By contrast, the aviation industry in the interwar years produced a series of ever more modern and effective planes in all categories (fighters, bombers, seaplanes, etc.), which extended and complemented the existing capabilities of the fleet. Today such markets may not exist where needed.

Third, because its intent is to *re*constitute forces—i.e., those known at the outset—reconstitution necessarily cannot readily accommodate technological breakthroughs that revolutionize those forces, such as nuclear weapons or nuclear submarine propulsion. Reconstitution planning may even be nullified by such radical advances, which render obsolete what went before them. At best, reconstitution efforts may contribute to such breakthroughs, but only secondarily or indirectly.

Fourth, reconstitution may be hindered or fail for political reasons. Weapon systems acquisition is, for major systems at least, an essentially political process. Programs to develop such systems die without partisan political support.[45] In the mid-1930s the Navy did not get the appropriations to build all the ships the Vinson-Trammell authorization allowed. Moreover, President Roosevelt would not even ask Congress for the money necessary to man existing ships at full strength. What the Navy could do to reconstitute its industrial base was limited by political constraints having nothing to do with strategic planning. The Army was held back by even greater political handicaps.[46]

Fifth, some of the most important elements of reconstitution may be informal, such as personal contacts between industry executives, engineers, and scientists and their counterparts in government. A successful reconstitution policy must not be haphazard, but neither may it overlook opportunities. In the 1930s, naval officers viewed the problem of amphibious assault as mainly one of developing suitable boats. It took a Marine to focus on armored, amphibious tractors, and that happened only after "surge"-phase funds had made a review of commercial products feasible. Similarly, one of the great "force multipliers" developed before World War II was naval code-breaking. The relationships between cryptologists in the Office of the Chief of Naval Operations and the firms that built their equipment (IBM and National Cash Register) had to be circumspect. The purpose of the equipment could never be revealed, yet it had to be obtained, and Navy personnel had to be trained in its use by company representatives. All had to be done within the standard contracting process without revealing the real intent of the procurements.

The key point is that reconstitution is a tricky policy. It is a gamble—that it will "fly" politically, that it will work if it does "fly," and that potential enemies will respect it enough not to test it. However, there are a number of steps that can and should be taken within the U.S. Navy to improve the odds.

- The proper meaning and actual impact of reconstitution should be explored in simulations and games. Doing so before World War II might have revealed how dangerous was the policy of not giving its three "pillars" equal attention.
- Responsibility for reconstitution should not be centralized in one office in the Defense Department. The reason is that reconstitution is not one activity, or one kind of activity, but many kinds of activity, from training reservists to tracking people with critical engineering skills, from investing funds in industrial facilities to adapting military plans and procedures to commercially produced technology. So many diverse activities cannot be controlled, but they do need to be coordinated.
- Developing a reconstitution policy must take politics and its potential strategic costs into account. Not only partisan politics, as discussed above, are

involved. Just as commercial industry in the interwar years was hostile to government industrial facilities (like the Naval Gun Factory in Washington, D.C.), the aerospace industry today sees military aviation depots as a threat to its survival. There can be no easy objective resolution of this tension between government and industry, but there must be a political accommodation.

• During reconstitution, more, by definition, must be done with less; innovation must occur in at least some fields despite a decline in funding. In the 1920s and 30s, communication of advances within some industries and between some industries and government was rapid because the number of people working in those particular areas was small. In 1930, for example, there were only about a hundred employees in the headquarters of the Navy's Bureau of Aeronautics, and new single-engine aircraft were flight tested at the Anacostia Naval Air Station, just a trolley ride from the headquarters of the Bureau. The small size of the aviation community—users and producers—facilitated communication, and the simple, rudimentary oversight procedures for research, development, and acquisition kept bureaucracy at bay. Any future reconstitution policy must take into account both the need for inter-organizational communication and the importance of informal personal contacts.

• Finally, reconstitution must consider both the ethics and the experience of the people in the "military-industrial complex." The tendency to use public resources for private gain is always great, as is industry's desire to maintain its payrolls. At the same time, the experience of the 1920s and 30s suggests that it is essential for those who implement reconstitution, surge, and mobilization to have been close to war production and defense management. The "cast of characters" who laid the foundation for the Navy's great mobilization during World War II were intimately involved with management, manufacturing, engineering, and finance. A "military-industrial complex" is both unavoidable and useful; policy must guide it in the right direction, rewarding innovation and integrity and discouraging inefficiency.

Ultimately, the real problem with pre–World War II mobilization planning—and it is one that encompasses lessons to be learned and recommendations to be made—was that it had no impact on America's potential enemies. The great industrial capacity of the U.S. did not deter Germany and Japan. Today's definition of reconstitution requires that it serve to deter war. *No one knows how that can be done.*[47] Does the capacity to produce high-technology systems deter? Not, apparently, in the case of nations such as Iraq. Is the ability to produce simpler systems in quantity a deterrent? Not according to the services. Is the ability to plan for expansion in quantitative and qualitative terms a deterring

factor? There is no evidence to suggest that it is. The psychological, perceptual side to reconstitution is critical to its success as a policy. The evidence from the years before World War II is not reassuring on this point.

Notes

1. I.B. Holley, Jr., *Buying Aircraft: Materiel Procurement for the Army Air Forces* (Washington: Office of the Chief of Military History, Dept. of the Army, 1964), p. 151.

2. That actually left *three* manufacturers, because one, the Naval Aircraft Factory in Philadelphia, was Navy-owned.

3. Newport News, Bethlehem, and New York Shipbuilding built railroad equipment. Newport News began building water turbines in 1922; by 1943 it was a leader in the field. See *Historical Transactions, 1893–1943*, The Society of Naval Architects and Marine Engineers (New York: 1945), "Part 3, Private Shipyards."

4. Holley, pp. 12–7.

5. *Ibid.*, p. 49.

6. The Navy had negotiated a contract with the Curtiss company to design and build an advanced scout bomber, the CS. The cost of development exceeded by a wide margin the negotiated payment. To recoup its investment, Curtiss set its production price (per plane) high and was underbid by Martin. This incident made a deep impression on the fledgling industry. *Ibid.*, pp. 85–6.

7 *Ibid.*, pp. 89–92.

8. J.H. King and R.S. Cox, "The Development of Marine Watertube Boilers," *Historical Transactions, 1893–1943*, Society of Naval Architects and Marine Engineers, pp. 496, 500.

9. Norman Friedman, *U.S. Destroyers: An Illustrated Design History* (Annapolis, Md.: Naval Institute Press, 1982); *U.S. Aircraft Carriers: An Illustrated Design History* (Naval Institute Press, 1983); and *U.S. Cruisers: An Illustrated Design History* (Naval Institute Press, 1985).

10. H.G. Bowen, *Ships, Machinery and Mossbacks* (New Jersey: Princeton Univ. Press, 1954).

11. *Ibid.*, pp. 128–9.

12. Holley, pp. 151–2.

13. R.H. Levine, *The Politics of American Naval Rearmament, 1930–1938* (New York: Garland Publishing, 1988), pp. 53–4.

14. R.H. Connery, *The Navy and the Industrial Mobilization in World War II* (New Jersey: Princeton Univ. Press, 1951), p. 125.

15. Bowen, p. 82.

16. *Ibid.*, p. 44.

17. *Ibid.*, p. 56.

18. This prospect came true during World War II when industrialist Henry J. Kaiser had his built-for-the-duration shipyards assemble Liberty ships from already completed subsystems at a lower cost and at a faster rate than traditional yards could build them "from scratch."

19. Levine, pp. 92–5.

20. Vinson-Trammell also instructed the Secretary of the Navy to procure 10 percent of the Navy's aircraft from "Government aircraft factories," which meant the Naval Aircraft Factory in Philadelphia. W.F. Trimble, *Wings for the Navy: A History of the Naval Aircraft Factory, 1917–1956* (Annapolis, Md.: Naval Institute Press, 1990), pp. 121–2.

21. The 10-percent ceiling was later extended to Army Air Corps contracts. See Holley, p. 35. According to Holley's account, the Army also used public works money for purchasing aircraft (p. 67).

22. F.C. Lane, *Ships for Victory: A History of Shipbuilding under the U.S. Maritime Commission in World War II* (Baltimore: Johns Hopkins Press, 1951), p. 23.

23. King and Cox, p. 505.

24. Holley, p. 22.

25. That same month, the carrier USS *Enterprise* (CV 6) was commissioned.

26. I.B. Holley, Jr., *Ideas and Weapons* (New Haven: Yale Univ. Press, 1953).

27. Memo, "Radio Controlled Target Airplanes—Exercises with during current quarter, advance partial report," from Commander in Chief, United States Fleet, to Chief of Naval Operations, 12 February 1939 (41-10/0245), Serial No. 3908, General Board No. 436, Records of the Navy's General Board, p. 1.

28. On 14 June 1940, Congress passed the Naval Expansion Act of that year. The Act authorized an increase in aircraft carrier tonnage of almost 80,000 tons and an increase in the number of useful aircraft to

4,500. On 15 June Congress pushed the number of useful aircraft to 10,000. On 19 July it raised the ceilings to 200,000 *additional tons* of aircraft carriers and 15,000 aircraft.

29. Lane, pp. 33–8.
30. Connery, p. 16.
31. *Ibid.*, pp. 61–5.
32. *Ibid.*, pp. 124, 192.
33. C.G. Reynolds, *Admiral John H. Towers* (Annapolis, Md.: Naval Institute Press, 1991), p. 339.
34. Economist Eliot Janeway cites Army Chief of Staff General George Marshall on this point. See Janeway, *The Struggle for Survival: A Chronicle of Economic Mobilization in World War II* (New Haven: Yale Univ. Press, 1951), p. 204.
35. Reynolds, in his study of John Towers, describes the many contacts between naval and army aviators in the years leading up to World War II as well as the cooperation between Towers and his army counterparts during the period of surge. See *Admiral John H. Towers*, chaps. 11 and 12.
36. Holley, *Buying Aircraft*, p. 519.
37. *Ibid.*, p. 525. On p. 532, Holley notes that between one-fourth and one-half of the total labor devoted to turning out military aircraft was "spent" at post-production modification centers.
38. When the Navy decided to build jet aircraft, it contracted with McDonnell Aircraft (January 1943). McDonnell was chosen not only because the firm had the necessary resources but also because it was *not* engaged in the mass production of aircraft for use in World War II. The Navy's Bureau of Aeronautics did not want the high rates of production in firms such as Grumman and Vought to slip.
39. Lane, p. 5.
40. *Ibid.*, p. 8.
41. Holley, *Buying Aircraft*, p. 548.
42. *Ibid.*, p. 27.
43. A.R. Buchanan, ed. (Aviation History Unit, OP-519B, DCNO [Air]), *The Navy's Air War* (New York: Harper, 1946), Part V.
44. Friedman, *U.S. Aircraft Carriers: An Illustrated Design History*, pp. 90, 111.
45. T.L. McNaugher, "Weapons Procurement: The Futility of Reform," *International Security*, Fall 1987.
46. The Army Air Corps did not even have enough bombers in the 1930s to test its concept of daylight strategic bombing.
47. However, even a deliberate policy of telling a potential enemy what U.S. science and industry can do may not deter the potential antagonist from becoming an actual one. As Dr. William Armstrong, Naval Air Systems Command Historian, has observed, if Admiral Yamamoto could not convince his nation's leaders of U.S. industrial potential before World War II, how could President Roosevelt be expected to have done any better?

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Sixteenth Military History Symposium

The United States Air Force Academy will hold the Sixteenth Military History Symposium, "Tooling for War: Military Transformation in the Industrial Age," 21–23 September 1994. For further information, contact Major John Farquhar, HQ USAFA/DFH, 2354 Fairchild Drive, Suite 6F37, USAF Academy, CO 80840-6246, or phone (719) 472-3230, fax (719) 472-2970.