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Industrial Mobilization in World War I: Implications for Future Great Power Conflict

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Abstract

For approximately 25 years, the United States was the world's sole superpower. With the emergence of China as a peer competitor on both the economic and military fronts, that era has come to an end. The prospect for near-future, industrial-scale, non-nuclear warfare can no longer be dismissed. Should that occur, it would be irresponsible to assume that a military decision would quickly ensue, therefore industrial (and societal) mobilization would be necessary. When considering this type of future, it is natural to look to the most recent historical example for guidance, and that would be World War II, in which America's supremely effective industrial mobilization created the well-known "arsenal of democracy" that the enemy was not able to counter.

In this paper, we propose that while the World War II story is instructive, the run-up to World War I in which America's industrial mobilization was far less effective, should not be ignored. This paper takes an introductory look at the failure of U.S. industrial mobilization in World War I, focusing on the case of shipbuilding. We review similarities and contrasts to today's situation and suggest courses of action to reduce the likelihood of a similar outcome in the future.

Introduction

The total collapse of the Soviet Union in 1991, which took the West by surprise, thrust the United States into a new and unexpected role as the world's sole superpower (Department of State, 2001–2009). The U.S. Navy suddenly exercised uncontested control of the high seas. Absent a high-end military threat, defense spending (including naval construction) was curtailed during the balance of the 1990s as resources were shifted to serve economic rather than military objectives. In that manner the American people looked forward to reaping a peace dividend. As the ex-Soviet fleet quickly deteriorated, the U.S. Navy's principal role was re-directed toward projecting influence and power ashore. Following the attacks of September 11, 2001, the prospect of a peace dividend vanished as the military budget grew. But military operations in the post-911 era were focused on land warfare, and naval ship production rates did not expand appreciably. There was little urgency to developing plans to mobilize the shipbuilding industry in response to aggression from enemy naval forces capable of inflicting severe losses at sea.



This frame of mind ended in the mid- to late-2010s. The current geopolitical environment has become characterized by “overt challenges to the free and open international order and the re-emergence of long-term, strategic competition between nations” (DoD, 2018). The result is a renewed potential for non-nuclear, industrial-scale war. If such a war were to break out against a peer-level enemy or against an alliance of multiple peer-level enemies, historical precedent suggests that demands on the U.S. Navy could quickly ratchet up.

The most recent major mobilization of the shipbuilding industry occurred prior to and during World War II. The World War II shipbuilding effort encompassed every type of naval and merchant ship, plus emergent types not envisioned prior to hostilities. The U.S. economy, directed and controlled by the State, performed brilliantly as described in an extensive literature that includes several recent book-length treatments (e.g., Wilson, 2016; Baime, 2015, & Herman, 2012) along with older classics such as Lane (1951), a standard text on the Emergency Shipbuilding Program of the Second World War.

The rapid and effective mobilization and expansion of war production (including shipbuilding) in World War II is a popular story due in part to its success, which was unprecedented. But the World War II effort was not original. It was preceded by a very similar push to mobilize U.S. industry, with a major focus on shipbuilding, in World War I. Responsible preparation for a future industrial-scale, non-nuclear war involving naval combat and trans-ocean supply lines would require an understanding of the World War I experience.

Shipping and Shipbuilding Actions Prior to U.S. Entry into the War

Prior to World War I, the world’s dominant shipbuilder was Great Britain (see, for example, Stott, 2017).¹ At the early stages of the war, the British believed that the key maritime asset needed to defeat Germany was a large battle fleet, so naval construction was prioritized over merchant shipbuilding. Consequently, British commercial shipping deliveries actually dropped; the merchant ship tonnage delivered in 1915–1916 was only one third of that delivered in 1913–1914. French industry was unable to respond as resources were fully occupied in ground fighting. U.S. shipyards, which had been depressed prior to the war, responded and were quickly filled with new orders (Williams, 1989, pp. 38–41).

From 1915 to 1916, German U-boat action took a heavy toll as Germany attempted to counter-blockade Great Britain. In 1916 German submarines sunk one of four ships bound for the U.K. and continental Europe (Hutchins, 1948, p. 52). “By the spring of 1916, the amount of tonnage sunk each month by German U-Boats began to overtake the amount of new tonnage delivered” (Williams, 1989, p. 41). The most pressing need now was for cargo-carrying merchant ships. The British revised their industrial priorities; however, it was not enough. U.S. shipbuilding was needed to plug the gap.

The Shipping Act of 1916 established a new U.S. Shipping Board that was empowered and capitalized to form a subsidiary corporation for the purpose of building and

¹ Great Britain led the development of the steel shipbuilding industry, but its global market declined “from over 80% in the 1890s to zero by the end of the 1980s” (Stott, 2017).



operating merchant vessels. The Naval Act of 1916 provided for naval construction to be ramped up. Its general objective was to build a powerful battle fleet; motivated by battleship and battlecruiser action in the Battle of Jutland (May 31–June 1, 1916). Naval ships were constructed at the Navy yards and at the large, pre-existing private-sector shipyards, such as New York Shipbuilding (Camden, NJ), Newport News, Fore River, Union Iron Works, Bath Iron Works, William Cramp & Son, and Electric Boat.

The Three Sectors of the Shipbuilding Industry (New Construction)

The United States declared war on Germany on April 6, 1917, and this spurred industrial mobilization to build warships and merchant ships. The ship new construction industrial base comprised three sectors:

1. Navy yards
2. Existing commercial shipyards
3. Emergency commercial shipyards

Each had distinct industrial characteristics and business bases. The Navy yards built warships, and the existing commercial shipyards built warships and a variety of merchant ship types. The emergency shipyards were a special case. Most, including the three largest, did not exist prior to the war. These emergency shipyards were “pop-up” facilities urgently constructed with government funding to build merchant ships quickly to overbalance the attrition from the German submarine campaign.

Naval Construction

Upon the entry of the United States into the war, naval shipbuilding underwent a complete change of plan in terms of both the quantity ordered and the mix of ship types. This is shown in Table 1, which traces U.S. naval ship production from shortly before the turn of the 20th century through World War I.



Table 1: Naval Vessels Delivered by Year, U.S., 1898–1922

(Smith & Brown, 1948, pp. 115–117)

Year	No.	Displacement tonnage	Average displacement	No. of battleships	No. of cruisers	No. of torpedo boats	No. of destroyers	No. of submarines	No. of other types
1898	12	28,111	2,343		1	3			8
1899	8	24,259	3,032	2					6
1900	6	13,349	2,225	1		3		1	1
1901	8	24,550	3,069	2		1			5
1902	17	24,560	1,445	1					16
1903	15	24,573	1,638	1	1			6	7
1904	5	22,362	4,472	1	3				1
1905	9	72,505	8,056		7				2
1906	10	140,192	14,019	6	4				
1907	9	90,743	10,083	4	2			3	
1908	9	85,435	9,493	3	5			1	
1909	16	81,135	5,071	2			4	6	4
1910	12	77,385	6,449	2			7	1	2
1911	12	61,872	5,156	2			9		1
1912	17	77,598	4,565	2			6	7	2
1913	11	81,849	7,441				4	3	4
1914	20	66,080	3,304	2			4	10	4
1915	11	33,765	3,070				7	1	3
1916	22	160,805	7,309	4			9	7	2
1917	16	77,289	4,831	1			5	5	5
1918	89	155,642	1,749	1			44	36	8
1919	157	221,255	1,409	1			104	22	30
1920	94	171,141	1,821	1			79	10	4
1921	40	172,974	4,324	2			28	5	5
1922	12	24,286	2,024	one aircraft carrier			3	8	1

Note. Other types include minelayers, minesweepers, ammunition ships, fuel ships, tenders, monitors, and others.

Prior to World War I, the European great powers plus the United States and Japan had engaged in a naval arms race prominently geared towards fleet operations and featuring battleships and cruisers. Unexpectedly for all belligerents, World War I naval combat followed a different course. Table 1 shows that the U.S. Navy shipbuilding plan was revamped to prioritize destroyers and submarines rather than capital ships, but the re-orientation and the ramp-up did not happen quickly enough. While the armistice was signed in 1918, peak output was not reached until 1919.

The major naval fighting ships (battleships, destroyers, and submarines) were built at a variety of shipyards including all three types, that is, Navy yards, existing private sector yards, and a new emergency yard, as shown in Table 2. The emergency shipyard that was purpose-built for destroyer production was the Navy-owned, Bethlehem Shipbuilding Corporation-operated facility at Squantum, MA. That yard followed the concept of the merchant ship emergency yards and was designed to build a single ship-type (destroyers) in large numbers. The shipbuilding supplier industries required rapid expansion along with the shipyards. For example, in conjunction with the construction of the new Squantum shipyard, the Navy also built a new boiler shop in Providence, RI, and a turbine shop in Buffalo, NY. The Navy financed facilities expansion at other existing shipyards, including the Newport News shipyard and the New York Shipbuilding Corporation yard in Camden, NJ, along with expansions to other critical suppliers such as Erie Forge (DoN, 1921).



Table 2: Shipyards That Built Major Warship Types From 1913 to 1922

(Smith & Brown, 1948, p. 132)

Shipyard	Location	Major warship types built
Bath Iron Works	Bath, Me.	Destroyers
Bethlehem Shipbuilding Corp. (Fore River)	Quincy, Mass.	Battleships, destroyers, submarines
Bethlehem Shipbuilding Corp.	Squantum, Mass.	Destroyers
Bethlehem Shipbuilding Corp. (Union Iron Works)	San Francisco	Destroyers, submarines
California Shipbuilding Co.	Long Beach, Calif.	Submarines
Craig Shipbuilding Corp.	Long Beach, Calif.	Submarines
Cramp, William and Sons	Philadelphia, Pa.	Destroyers, submarines
Electric Boat Co.	Groton, Conn.	Submarines
Lake Torpedo Boat Co.	Bridgeport, Conn.	Submarines
The Moran Co.	Seattle, Wash.	Submarines
Newport News Shipbuilding and Dry Dock Co.	Newport News, Va	Battleships, destroyers
New York Shipbuilding Corp.	Camden, N.J.	Battleships, destroyers
Seattle Construction and Dry Dock Co.	Seattle, Wash.	Destroyers, submarines
Charleston Navy Yard	Charleston, S.C.	Destroyers
Mare Island Navy Yard	Vallejo, Calif.	Battleships, destroyers
New York Navy Yard	Brooklyn, N.Y.	Battleships
Norfolk Navy Yard	Portsmouth, Va.	Aircraft carriers, destroyers
Portsmouth Navy Yard	Portsmouth, N.H.	Submarines
Puget Sound Navy Yard	Bremerton, Wash.	Submarines

Note. Shown are shipyards that built battleships, destroyers, and submarines, i.e., the principal fighting ships. No cruisers were built in this period.

Merchant Ship Construction

The U.S. shipbuilding industry had become very active following the 1914 outbreak of the war, as the British shipyards were filled to capacity with orders. On April 16, 1917, 10 days after the declaration of war on Germany, the U.S. Shipping Board created the Emergency Fleet Corporation; all of the shares were held by the Shipping Board. The Shipping Board was essentially regulative, with the Emergency Fleet Corporation being its operational arm. The initial organization of the Shipping Board was badly flawed, leading to unresolvable technical and managerial disputes at the top level. In late July 1917, senior leadership was replaced with a more effective line-up and the World War I shipbuilding program got under way in earnest. But the political and bureaucratic paralysis cost the program four months that proved impossible to recover.

On July 11, 1917, under its new and more energetic leadership, the Emergency Fleet Corporation took control of the U.S. shipping and shipbuilding industries. It requisitioned all 431 steel merchant ships under construction in U.S. shipyards, totaling 3,068,431 deadweight tons (Hutchins, 1948). This was not enough however, and what followed was “the greatest flood of ship orders in American history. The task was indeed the largest shipbuilding effort in the world’s history up to that time” (Hutchins, 1948, p. 52). It is worth quoting Hutchins at length here:

In 1917, before the entry of the United States into the war, the shipbuilding industry had already grown to forty-two yards with 154 ways for steel ships. ... Before 1914, about 75 per cent of the country’s shipyard capacity was normally engaged in naval work. By 1919, however, the capacity had risen to seventy-two steel shipyards with 461 ways. ... The



yards were then engaged in the construction of more commercial than naval tonnage.² (Smith & Brown, 1948)

The need far exceeded the capacity of the existing shipbuilding industry.³ The construction of new emergency shipyards and the enlargement of existing ones was necessary. Hurley (1927) described the situation as follows:⁴

Originally it was supposed that the main function of the Fleet Corporation would be that of developing designs and placing contracts for ships. But all the yards were either busy in completing for the Fleet Corporation the 431 hulls which we had commandeered, or were clogged with orders for the Navy. The shipyard owners, found that they could not control the supply of either material or labor. Hence the Fleet Corporation had to step in and manage the yards. Entirely new yards had to be built, at an expense so huge that it could not be defrayed by private companies. In the end the Fleet Corporation had to build the yards with government money and to act as their banker.

The Emergency Fleet Corporation contracted for three new large shipyards to be built by private-sector firms. The largest was the Hog Island shipyard in Philadelphia.⁵ This facility was owned by the American International Corporation, which also owned the huge, modern New York Shipbuilding Corporation yard in Camden, NJ. Hog Island (and the other purpose-built yards) built ships to a standard design, employing newly conceived prefabrication methods on a massive scale. Hog Island “built 122 ships of 921,000 deadweight tons between the laying of the first keel ... on Feb. 12, 1918 and the completion of its last vessel on Jan. 29, 1921, averaging a keel every 5.5 days.” Of those 122 ships, 110 were of the pre-fabricated standard Hog Island 7,600 dwt freighter. The yard had 50 slipways but not as many shop facilities as a conventional shipyard, as many parts and components were manufactured elsewhere. Peak employment was 30,000. (Hutchins, 1948, pp. 54–55; Goldberg, 1991, pp. 3–14). See Table 3 for a summary of activity at the Emergency Fleet Corporation shipyards.

² Table 10 lists the 70-odd shipyards.

³ Merchant ships were so desperately needed that the Shipping Board placed orders in Japanese and Chinese shipyards (Goldberg, 1991, p. 3).

⁴ Edward N. Hurley was appointed chairman of the U.S. Shipping Board in July 1917 as part of the USSB’s reorganization.

⁵ The others were the Newark shipyard of the Submarine Boat Company and the Bristol, PA, yard of the Merchant Shipbuilding Corporation.



Table 3: World War I Emergency Shipyards

(Shipbuildinghistory.com, Tim Colton, accessed Feb. 13, 2019)

Firm	Shipyard location	No. of ships delivered to USSB	No. delivered to USSB before Nov. 1918
East Coast (13 yards)			
American International Shipbuilding	Hog Island, Pa.	122	0
Atlantic Corporation	Portsmouth, N.H.	10	0
Carolina Shipbuilding	Wilmington, N.C.	8	0
Downey Shipbuilding	Arlington, N.Y.	10	0
Foundation Company	Kearny/Newark, N.J.	10	5
Merchant Shipbuilding	Bristol, Pa.	40	0
Newburgh Shipyards	Newburgh, N.Y.	12	0
Pusey and Jones	Gloucester City, N.J.	20	3
Standard Shipbuilding	Shooters Island, N.Y.	23	7
Submarine Boat Company	Newark, N.J.	118	0
Terry Shipbuilding	Savannah, Ga.	11	0
Texas Steamship Company	Bath, Me.	4	4
Virginia Shipbuilding	Alexandria, Va.	12	0
Gulf Coast (7 yards)			
Oscar Daniels Shipbuilding Company	Tampa, Fla.	10	0
Doullut and Williams	New Orleans, La.	8	0
Foundation Company	New Orleans, La.	5	0
Mobile Shipbuilding	Mobile, Ala.	14	1
National Shipbuilding	Orange, Tex.	12	1
National Shipbuilding Corporation	Violit, La.		
Pensacola Shipbuilding	Pensacola, Fla.	10	0
Midwest (2 yards)			
Globe Shipbuilding	Superior, Wis.	19	4
Saginaw Shipbuilding	Saginaw, Mich.	18	2
West Coast (10 yards)			
Ames Shipbuilding and Dry Dock Company	Seattle, Wash.	25	7
Columbia River Shipbuilding	Portland, Ore.	32	8
J.F. Duthie and Company	Seattle, Wash.	27	12
Hanlon Dry Dock and Shipbuilding Company	Oakland, Calif.	11	4
Northwest Steel	Portland, Ore.	34	13
Pacific Coast Shipbuilding	Bay Point, Calif.	10	0
Seattle North Pacific Shipbuilding	Seattle, Wash.	10	0
Skinner and Eddy	Seattle, Wash.	40	25
Supple-Bollin Shipbuilding	Portland, Ore.	12	8
Union Construction Company	Oakland, Calif.	10	0
	Sum:	707	104

Note.

1. A few of these yards completed a small number of later ships, for example, USSB cancellations that they were able to complete for private-sector ship owners.
2. Dozens of cargo ships were delivered to the French government by various emergency shipyards.
3. A few additional emergency yards built smaller ships of less than 1,000 gross tons.



As seen in Table 3, the Hog Island shipyard achieved a prodigious output. But its first ship, the *Quistconck*, was delivered in December 1918, too late for World War I service.⁶ This must have been a colossal frustration at the time, and it is the general theme of the World War I merchant and naval shipbuilding effort: technically impressive, far in front of shipbuilding thinking elsewhere in the world, but ultimately did not contribute to victory in the war. The Hog Island shipyard was promptly closed down and demolished after the last delivery in 1921; much of the site is now the Philadelphia airport. However, the effort was a valuable dress rehearsal for World War II, in which the same theme of ship manufacturing in huge, purpose-built facilities was adopted with much more timeliness.

The merchant shipbuilding program's results in Table 3 paralleled those of the naval construction program: impressive industrial mobilization, but too late for most of the ships to come on line during the war (see Figure 1). This effect was exacerbated in the merchant vessel program, as most of the shipyards did not exist before the hostilities, and the largest did not exist until after U.S. entry.

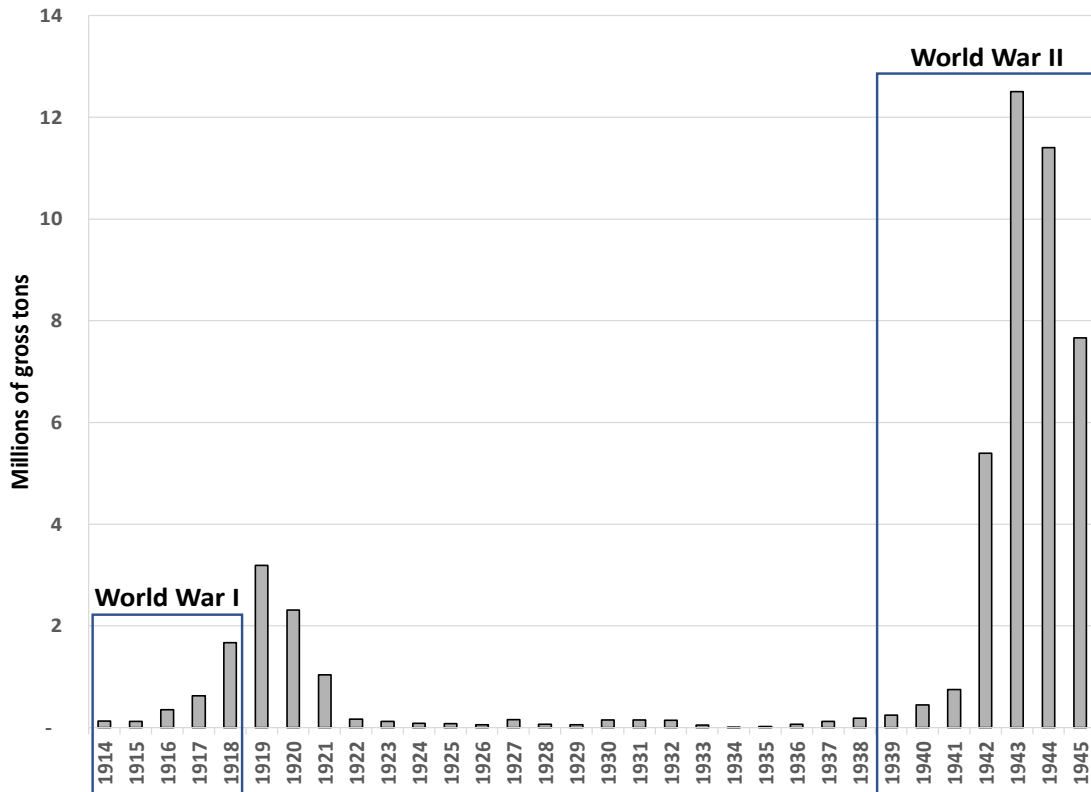


Figure 1. Gross Tons of Steel Merchant Ships (over 2,000 gt) Delivered 1914–1945
(Smith & Brown, 1948)

⁶ See <http://www.shipbuildinghistory.com/shipyards/emergencylarge/aisc.htm>. Accessed Feb. 11, 2019.



Discussion and Recommendations

The U.S. World War I shipbuilding program was not effective because it started well after World War I was underway, and because of poor management in its initial stages. World War I began in August 1914, and by the end of that year it was clear that it would be a long desperate struggle, yet the United States made few preparations for naval construction until the Naval Act of 1916. Seven months later, in April 1917, the United States entered the war, and at that point the Emergency Fleet Corporation still had not been created.

The contrast to the World War II experience is stark. A ramp-up in ship orders for that war started at the expiration of the naval arms limitation treaties in 1936, three years prior to European theatre hostilities. As early as 1939, efforts were initiated to expand industrial capacity. During America's pre-War period (1936–1941), 182 destroyers were authorized and 39 were delivered.

The World War I experience suggests some food for thought in preparation for the onset of future industrial-scale, non-nuclear, global war. A few samples are offered in the next paragraphs.

1. Investments in options could increase industrial capacity rapidly. This would include the shipbuilding industrial base and the critical supplier base of facilities that take the same general timeframe to ramp up as a shipyard. This could include foundries, forges, specialty machine shops, and other types of production facilities, and capacity for development of software infrastructure for naval and commercial ships.
2. Merchant marine and merchant shipbuilding policies may be due for a reexamination. In past global wars, merchant fleets have been instrumental tools of military strategy. They were required to reposition ground forces, their gear, and supplies between overseas theatres of war. The U.S. merchant marine has substantially atrophied since World War II. U.S. subsidy programs supporting the foreign trading segment of the merchant marine have not been funded since the early 1980s.⁷ Before 1914, approximately 75% of U.S. shipbuilding industrial capacity was engaged in Navy new construction. But at the height of World War I, after tremendous capacity expansion, there were more merchant ships being built than warships even though most of the warships being built were small. In World Wars I and II, at the point when the situation was grimmest for the allied powers, merchant shipbuilding was by far the #1 priority, not warship construction.
3. In preparation for high-volume wartime production, creation of detailed designs of merchant and naval ship types could be done in advance. If the two world wars are valid guidance (not known), then other ship types, including long-lead-time warships, would out of necessity be placed at lower priority.⁸ The corollary would be that those are the ship types that would be emphasized in peacetime in the absence of war exigencies.

⁷ The foreign trading segment of the merchant marine exists outside of the Jones Act legislative environment. Historically it was supported via mechanisms including subsidies and cargo preference programs (Gibson & Donovan, 2000).

⁸ World War I lasted less than 4 ½ years (including prior to U.S. involvement), so even for the European belligerents, no ships that took longer than that to build were able to be used during the war.



4. Prototype construction of some of those ship designs to work out design issues, production issues, and gain feedback from the operator for design mods may be an effective way to smooth the path to wartime volume production. For effective designs, it may be advantageous to store jigs and other critical tooling.
5. Ship design flexibility may be at a premium at the outset of a new industrial-scale conflict, due to the impossibility of accurately predicting the nature of future naval combat. In World War I, not only was the naval surface combatant production priority changed from capital ships to destroyers, the originally intended fleet combat role of the destroyers (e.g., torpedo attacks on enemy capital ships) never materialized. Instead, they were pressed into service convoying merchant vessels and conducting the world's first antisubmarine warfare campaign (Gardiner, 1985).

Conclusion

The industrial mobilization experience of the United States in World War II has been described and discussed in an extensive literature and is well known. One reason is that it is an uplifting story, and in significant ways it embodied the ideals upon which the best in American civilization is based. It was as the “arsenal of democracy” that America made, arguably, its most irreplaceable contribution to allied victory. A critical lynchpin of that effort was shipbuilding, where the result was achieved through the voluntary, dedicated labor of an unprecedented cross section of American society (including women and minorities) who were effectively mobilized with a common goal of building merchant ships to counter the effects of German submarine warfare.

In World War I, both the need and the means were almost the same, and yet the result was disappointing, even though the United States responded in a spectacular fashion, temporarily becoming the largest shipbuilding nation in the world, and the ships built during the World War I program “composed the great bulk of the American merchant marine until the construction program of World War II had effect” (Hutchins, 1948, p. 53). In this paper we have described the actions taken and that the results were too late to have as much effect as they could have had.

For an additional cautionary conclusion, we now take a big-picture look. We observe that the industrial mobilization outcome in the 1941–1945 war was fully informed by the 1917–1918 experience. For World War II, “the characteristics of that earlier period were ... again duplicated” (Hutchins, 1948, p. 57). In terms of industrial base strategy, industrial organization, and manufacturing technology, World War I served almost as a dress rehearsal for World War II. In a potential 21st century non-nuclear World War III, could the United States update the successful World War II script to achieve victory? Not likely, as too many variables (industrial, economic, geopolitical) have undergone fundamental change since 1945. Which brings us back to the World War I predicament: mobilizing the industrial base in a new economic environment, for a new type of war.

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