

# THINKING AHEAD. THE NAVAL WAR COLLEGE INFLUENCE ON WARSHIP DESIGN<sup>1</sup>

PENSANDO O FUTURO.  
A INFLUÊNCIA DO *NAVAL WAR COLLEGE* NA  
CONCEÇÃO DE NAVIOS DE GUERRA

**Nuno Correia Neves**

Colonel of infantry  
Military University Institute (IUM)  
Integrated Researcher at IUM Investigation and Development Center  
1449-027 Lisbon, Portugal  
neves.nc@ium.pt  
neves431@gmail.com

## Abstract

The aim of this article is to study whether the United States Navy original and innovative practice of using the Naval War College, its staff and students, as a “think tank” to assist the Navy General Board on setting the path for the development of future warships was a long term advantage and constitutes a possible reference model for the cooperation between military academic institutions and high level decision making staffs on the defense sector.

**Keywords:** Naval War College, Think Tank, War Games, Warships, Innovation.

## Resumo

O objetivo deste artigo é avaliar se a prática original e inovadora da Marinha dos Estados Unidos de utilizar o Naval War College, os seus professores e alunos, como um “Think Tank” para auxiliar a definir o rumo para o desenvolvimento de novos navios teve vantagens e se constitui uma possível referência para a cooperação entre instituições académicas militares e os órgãos superiores ao nível da defesa nacional.

**Palavras-Chave:** *Naval War College*, *Think Tank*, Jogos de guerra, Navios de guerra, Inovação.

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## Summary

The period between the end of the XIX century and the end of the Second World War presented a major challenge for naval decision makers, the rapid evolution of technology combining with the rise of new major international players such as the German, Japanese and United States Navies, to present a formidable intellectual challenge.

Instead of relying on a centralized Admiralty along the classical Royal Navy model, introduced in age of the Tudors and evolved through the centuries to become the almost universally accepted standard, the U.S. Navy used a far more decentralized decision process, that used the Naval War College as a forum for developing, testing and perfecting new concepts, turning it into what we would now call a “think tank” and taking advantage of having some of the best brains of the Navy, the teachers and the students of the college, concentrated at an academic environment.

In this article we will try to present the influence of the College in the development of U.S. Warship design, in order to establish the merits of using an academic institution on such a manner, using as a main source Norman Friedman’s excellent series of books on the development of U. S. warship design, complemented, of course, by the vast literature on the subject when needed.

### 1. The United States Navy design process

In the United States, as in most other countries, naval construction was supervised by civilian and military authorities. Civilian authority was exerted through congress that was responsible for allocating financial resources and through the secretary of the Navy. Naval authority was exercised, since 1842 onwards, by a linear organization of independent bureaus that reported to the Secretary of the Navy, an organization that lasted until 1966 (Friedman, 1984). These were the Bureau of Construction and Repair (C&R) responsible for hulls, the Bureau of Steam Engineering, later just Bureau of Engineering (BuEng), these two being merged in 1940 into the Bureau of Ships (BuShips), the Bureau of Ordnance (BuOrd) responsible for weapons and initially the Bureau of Equipment, abolished in 1910. Not directly related to warship construction, and serving as the facto main military advisor to the secretary until the Admiral of the Navy post was created in 1909, there was also a Bureau of Navigation that was responsible for managing the Navy’s personnel and routine operational matters.

Since all this Bureaus were on the same level, coordination was clearly an issue, and in 1889 a Board on Construction was created, formed by the chiefs of the bureaus and the Director of Naval Intelligence, ending the practice of forming temporary committees. After the Spanish-American war of 1898, and the experience of the temporary Naval War Board, the General Board was formed, but purely with an advisory status until 1915, when legislation both formalized the General Board as responsible for long term policies, and

established OPNAV as the organization responsible for current operations and readiness. The General Board was, from then, responsible for naval strategy, tactics and ship and weapons design (Friedman, 1984).

The U.S. Navy was then in the rather privileged position of concentrating in a single, compact organism, the responsibility for conceiving both future war plans and future warships, giving the board a considerable power, within congressional approved budgetary limits, to shape the future of the Navy. Like any other organization, it was, however, only as good as the intellectual power it could mobilize. What made it successful, and gave the U.S. Navy world naval leadership in consequence, was that rather than depending on the luck of having people who happened to be both excellent technocrats and daring tactical and technological innovators at the right post at the right time<sup>1</sup> (as the Royal Navy did when it had the luck<sup>2</sup> of having Admiral Fisher as a leader right at the start of a major naval race), the Board outsourced a lot of its most intellectual work to the people who were really good at it, the Naval War College.

## 2. The Naval War College method for testing future warship concepts

The Naval War College was founded in 1884, and from the 1890s also functioned as a war planning agency. To do so it relied not only on its staff, but also on its students, the annual class being involved in committees that studied major naval issues, not purely for educational but also for practical purposes, the College being, for example, responsible for the 1908 study that led to the abolition of the Board on Construction and the transference of its functions to the General Board (Friedman, 1984).

In 1886 Mahan, then president of the Naval War College, invited Lieutenant (Retired) McCarty Little, who had been one of the pioneers of North American naval wargames<sup>3</sup> to lecture on the value of war gaming (Figure 1), and in the 1890s the College started staging serious wargames and using them both as an educational and as a research tool. McCarty Little developed three levels of games, to test Ship Vs Ship action (The Duel), for Fleet Vs Fleet actions (Fleet Tactical Games), and for Nation Vs Nation wars (The Strategic Game). The games were played as a combined playing and discussion exercise, actual gaming taking place in the morning, and the afternoon being used for discussion of the days actions. Games could, according to complexity, last from a few days to a month and a half (Miller,

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<sup>1</sup> The Imperial Japanese Navy tried to force luck by selecting gifted individuals, regardless of rank, and asking them to formulate doctrinal concepts to be approved by the High Command. They did it for their battleships doctrine with Captain Sato Tatsutaro (Colombier, 2017) and for their aircraft carriers doctrine with Genda Minoru (Ehregardt, 2017). Their main problem was that once they had a doctrine they liked, they stuck with it, regardless of changing circumstances. This reliance on very junior officers must be understood within the context of Japanese traditional warrior culture that gave great importance to individual skill.

<sup>2</sup> Fisher did commit mistakes, but few would deny that he was a major driving force for progress in the Royal Navy.

<sup>3</sup> The first modern wargame was invented in Prussia by Baron von Reisswitz and perfect by his son, Lieutenant von Reisswitz in 1824, being adopted by the Prussian General Staff and spreading to other armies progressively. The first naval wargame was introduced in Britain in 1878 (Miller, 2001).

2001). The College was so enthusiastic about wargames that it devoted extensive facilities to it, the building of Pringle Hall in 1934 allowing an enlarged gaming area.



**Figure 1 – War gaming at Pringle Hall, 1947**

Source: <http://cimsec.org/send-crowd-war/10935>

Using wargames to develop plans was not exclusive of the Naval War College (Figure 2), the German General Staff under Graf von Schlieffen did it extensively to perfect plans at about the same time (Miller, 2001), but what was innovative was doing it at an academic institution for actual operational use<sup>4</sup>, and using them for testing new weapon concepts (Figure 3).

In U.S. Navy practice, the General Board, having established a strong working relationship in which the College was, “de facto” its think tank, used the wargames to conduct virtual tests of future warships before their design was approved, games being conducted with “conceptual” ships (sometimes in several alternative versions) and results compared. This process would allow the Navy to introduce innovative, well balanced ships that would prove extremely successful in two world wars, avoiding the costly mistakes that are often the consequence of “top down” innovation, such as, for example, Fishers’ “Large Light Cruisers”<sup>5</sup>.

Rather than attempting a chronological narrative of this working relationship, we will concentrate on a few cases, in order to demonstrate the relative merits of the U.S. Academic approach, versus the traditional development path followed by other nations.

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<sup>4</sup> The plan for invasion of the Philippines in 1944 was based on a Naval War College war game of fifteen years before (Miller, 2001).

<sup>5</sup> The Large Light Cruisers of the Courageous/Furious class were the more radical, and arguably the least successful, of Fisher’s concepts, being the size of battlecruisers, but with reduced firepower and armor.



Figure 2 – Naval war games were very popular in the late XIX, early XX century, much as web based games such as World of Warships are popular today

Source: <https://news.usni.org/2013/09/24/brief-history-naval-wargames>.

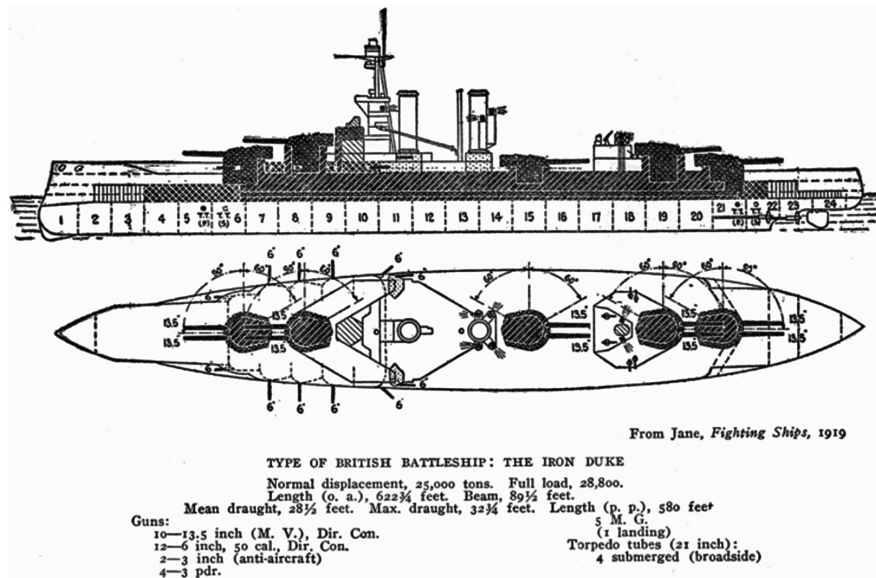


Figure 3 – The main international reference for naval wargames was Jane’s all the world warships, which is the reason why the profile drawings in old editions included numbered squares that would be used to keep score of damage in games, the drawing being copied into cardboard silhouettes for use in games and pins placed on the appropriate square.

Source: <http://i58.tinypic.com/2yobtcz.png>

### 3. All or nothing

Battleship development moved forward incrementally towards the start of the XX century, before entering a period of radical and dramatic expansion with the advent of the “Dreadnought” age. This progression demanded carefully balanced compromises between desired characteristics, battleships being inherently “weight critical” rather than “volume critical” as most other ships (Friedman, 1985), a factor that became artificially constraining when the Washington Naval Treaty set a limit on battleship displacement of 35.000 tons standard.

It was on deciding on the ideal compromise that the College wargames and conferences were more influential, from such prosaic matters as assuming load levels for fuel and ammo stores when estimating combat displacement (Friedman, 1985) to more radical changes, such as the all big gun battleship and the all or nothing protection scheme.

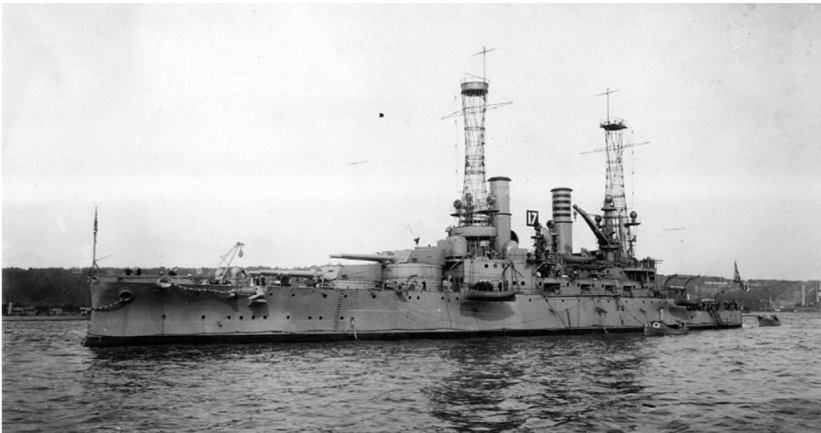
The first of the two was a fairly obvious change that resulted from a progressive increase in battle ranges leading to an increase in the caliber of the secondary batteries, to the point that it became practical to replace the two batteries by a single caliber main battery. This was most famously proposed by the Italian military officer and naval engineer Cuniberti in the 1903 edition of Jane’s, and it was Fisher’s determination and British building efficiency that allowed the Royal Navy’s to claim paternity of the idea, the new generation of battleships being therefore known as Dreadnoughts.

In fact the U.S. Navy had led the way, Lieutenant-Commander Poundstone having proposed in 1901 a ship with 12x11 inch guns<sup>6</sup> as an alternative to more conventional designs (Friedman, 1985). His ideas interested the General Board, and in 1903 the Naval War College conducted comparative wargames to test the value of the new concept, establishing that an all big gun battleship would be worth two to three conventional ones in combat, and also concluding that the secondary weapons would only be used for “beating off” destroyers making torpedo attacks, therefore being ideally limited to quick firing anti destroyer weapons.

It was only the slowness of the subsequent design and building process that prevented the new class of ships to be known internationally as “*South Carolinas*” rather than Dreadnoughts (Figure 4), but the advantages of war gaming future designs were evident in the much more advanced general layout of the U.S. ships, that adopted super firing turrets to obtain the same firepower of the British ones on 3000t less displacement.

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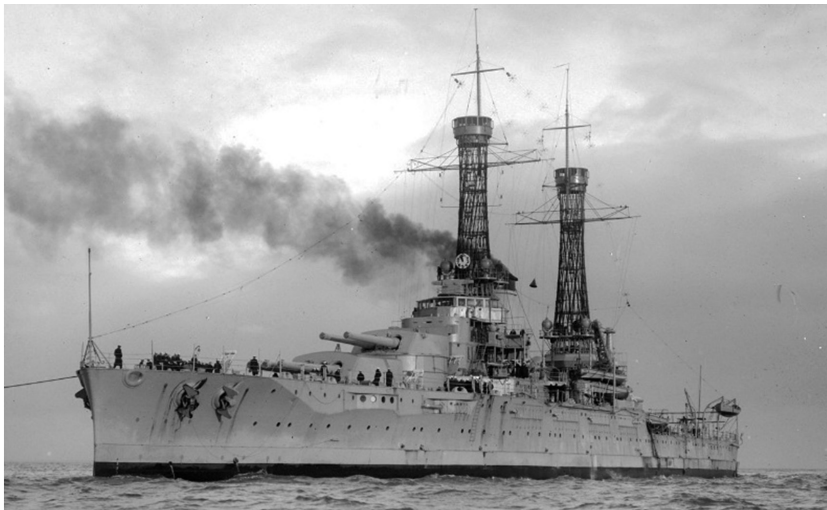
<sup>6</sup> Poundstone design used the exact main battery concept that would be adopted by the German Navy for their first *Dreadnoughts*, the *Nassaus*.



**Figure 4 – The USS Michigan, of the South Carolina class, the world’s first battleships with the classic superfiring 4x2 main battery**

Source: [https://en.wikipedia.org/wiki/USS\\_Michigan\\_\(BB-27\)](https://en.wikipedia.org/wiki/USS_Michigan_(BB-27)).

But it was the next big step in battleship design that was to demonstrate the advantages of the U.S. Navy process and allow the North Americans to overtake the British. They did it by introducing two major innovations, using only oil rather than coal or a mix of oil and coal for propulsion (a decision taken in 1910, two years ahead of the Royal Navy<sup>7</sup>), and by introducing the concept of all or nothing protection (Figure 5).



**Figure 5 – The USS Nevada, the world’s first all or nothing Battleship**

Source: [https://en.wikipedia.org/wiki/USS\\_Nevada\\_\(BB-36\)](https://en.wikipedia.org/wiki/USS_Nevada_(BB-36)).

<sup>7</sup> Once again the greater speed of British shipbuilding allowed the R.N. to catch up, the *Queen Elizabeth*'s being laid down in the same year of the *Nevada*'s

This was a result of studies demonstrating that battleship actions would be primarily fought at long range using armor piercing rounds<sup>8</sup>. It would therefore be useless to protect non vital parts of the ship with medium armor, wasting weight on armor that wouldn't stop heavy AP shells, but that it would be more advisable to protect only the vital areas of the ship with the thickest possible armor, leaving the rest of the vessel exposed<sup>9</sup>. The combination of these qualities made the *Nevada* class the most advanced battleships of its time, only rivaled by the British *Queen Elizabeth* class. The *Nevadas* were the first of a series of very similar battleships classes that were known in the U. S. Navy as the "standard" type. After the two *Nevadas* came the two *Pennsylvanias* with more guns (twelve rather than ten 14 inch), three similar *New Mexico* and two *Tennessee* (with better underwater protection) culminating in the three *Colorado* (out of four planned) that traded the twelve 14 inch guns for eight 16 inch guns in four twin turrets. This gave the U.S. Navy an impressive and homogenous battle line of twelve modern battleships to match the Royal Navy force of five *Queen Elizabeth* and five *Revenge* class<sup>10</sup>.

This evolution was based on a technological drive to meet the demands of the naval battles of the future, correctly predicted by the U.S. Navy to be long range actions with heavy A.P. shells, a prediction grounded on experience gained on the simulated seas of the Naval War College wargames.<sup>11</sup>

Wargames also proved valuable in rejecting apparently useful ideas that would have certainly have led to expensive failures, such as the torpedo battleship. Initially validated by a 1904 wargame, it was abandoned after the introduction of battle cruisers by the Royal Navy led to revised wargames that demonstrated that the idea of a battleship primarily armed with torpedoes would fail since battle ranges between fleets would increase, and such a ship would be likely heavily engaged with long range fire before having the possibility of making a surprise attack.

In another demonstration of the potential of academic wargames, the College concluded in 1913 that using battlecruisers in fleet actions would be an excessive risk, anticipating what actually happened at Jutland, and leading to the cancelation of U.S. intentions to build battlecruisers of the British type<sup>12</sup>, and pointing towards the fast battleship as a possible standard type (Friedman, 1984). This two instances demonstrate the value of wargames in evaluating how new types of ships would actually be used in combat.

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<sup>8</sup> The Royal Navy still advocated using high explosive shells at long range, not considering the possibility of plunging shell penetrating deck armor as being the most dangerous. Thirty years later *Bismarck* was to demonstrate against HMS *Hood* just how dangerous AP rounds at long range could be.

<sup>9</sup> Not, of course, totally exposed, some form of limited "splinter" protection being retained.

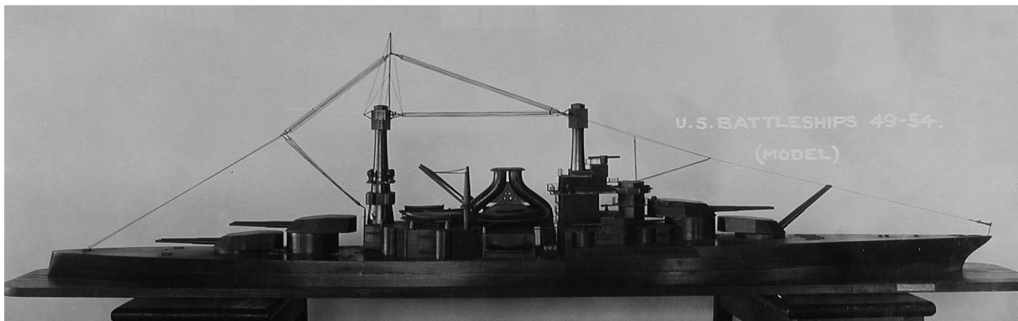
<sup>10</sup> To which the Royal Navy could add HMS *Hood*, classed as a battlecruiser but regarded as a fast battleship, (and as a very successful one) by most navies, including the U.S. Navy, at the time.

<sup>11</sup> The concept was adopted by the Royal Navy with the Nelson Class. World War Two experience was to demonstrate that while non all or nothing battleships such as the German *Scharnhorst* and *Bismarck* classes were very difficult to sink, they were easier to "mission kill" being reduced to targets after a few hits reduced their fighting ability. Another consequence of this line of thought was the concept of the "immune zone" to evaluate protection, the zone being defined by the least range at which vertical armor would stop a flat trajectory shell, and the greatest range at which deck armor would stop a plunging shell. This was a major step forward in both warship design and battle planning.

<sup>12</sup> The U.S. Navy would later decide to build battlecruisers but to a much revised concept.

The U.S. Navy also embraced the principle of collective responsibility and encouraged brainstorming, as demonstrated 1908 when a conference on battleship design was convened in Newport. It was attended by the General Board, notable Commanders and Engineers, but also by the staff of the Naval War College and the U. S. President, Theodore Roosevelt, who demanded that the final conclusions were the result of a nominal vote, each individual stating his position for the record, a decision process that shows the primacy of intellectual debate over seniority in the expanding U.S. Navy (Friedman, 1985).

Being confident of having matched the Royal Navy on quality, the U.S. Navy still hadn't matched her on numbers, and once the end of the Great War moved the focus from Plan Black (for war with Germany) once again to Plan Red (for war with Britain) wargames clearly demonstrated that the numerical superiority of the British would give them an almost sure victory (Miller, 2001). This argument led strength to the project of expanding the U.S. Battle fleet, the planned *South Dakota* battleships (Figure 6) outclassing all existing ships<sup>13</sup>, but the Board pushed for even better ships (Friedman, 1985). This led to a British response on the form of the excellent, but extremely expensive, G3 class battlecruisers and N3 class battleships, and to the 8/8 plan<sup>14</sup> in Japan (Ireland, 1997). The fact however, was that the war had left the British with a massive U.S. owned debt, and economic considerations forced Britain (and all the other naval powers) to accept a limitation on naval strength. This was to become the Washington Naval Treaty that guaranteed that the U.S. and British fleets would have parity in battleship<sup>15</sup> strength. The 1915 goal of a Navy second to none had been achieved.



**Figure 6 - A model of the cancelled South Dakota class of six battleships. With twelve 16 inch guns and capable of 23 knots, this were the ships that brought the major naval powers to the negotiation table and indirectly gave the U.S. Navy its goal of being “second to none”**

Source: [https://en.wikipedia.org/wiki/South\\_Dakota-class\\_battleship\\_\(1920\)#/media/File:Model\\_of\\_South\\_Dakota\\_class\\_battleship.jpg](https://en.wikipedia.org/wiki/South_Dakota-class_battleship_(1920)#/media/File:Model_of_South_Dakota_class_battleship.jpg).

<sup>13</sup> They would have 12 16 inch guns in four triple turrets and excellent protection.

<sup>14</sup> The first Japanese 8/8 plan (8 battleships and 8 battlecruisers) was introduced by Captain Sato Tatsutaro when he was a teacher at the Tsukiji Naval Warfare School, the Japanese Naval War College in 1907. It was constantly upgraded in terms of the characteristics of the ships, but retaining the parity in BC/BB numbers. With displacement raising rapidly, so did cost. Sato had also estimated that given the USN two oceans commitment, the IJN would require 70% of the USN battle strength. Since they got 60% without an expensive race, they accepted it as good enough after much internal debate (Colombier, 2017).

<sup>15</sup> More precisely in capital ship strength. The Royal Navy retained some battlecruisers in their total capital ship tonnage, while the U.S. Navy, having only battleships, had a small advantage on battleship tonnage.

The treaty both forced a pause in the building of battleships and battlecruisers, the limit for fleet size being adjusted to the displacement of the modern U.S. battle fleet<sup>16</sup>, and imposed size limitations, ships having to fall under a 35.000 tons limit that was to force serious design compromises, the only two battleships built in the 20s, the British *Nelsons*, being truncated and inferior versions of the G3 design. They were also the first British battleships to adopt the all or nothing protection concept, in a first major instance of the Royal Navy copying the U.S. Navy.

In battleship development, therefore, the Board/College partnership seems to have proved its superiority over the classical British Admiralty model. The three major evolutions in battleship design, single caliber heavy guns, all or nothing protection and all oil propulsion were all U.S. innovations that were adopted by the Royal Navy, even if the speed at which the British commissioned their ships tended to mask their less progressive conceptual environment, and the U.S. Navy avoided the Royal Navy<sup>17</sup> costly obsession with speed that led to under protected tactically unsound warships.

#### 4. Carrier Air Groups

Carriers appeared at the end of the Great War, and evolved through two decades of relative peace, without large scale fleet actions, with the consequence that their development had to be based on intellectually constructed models. The U.S. Navy resorted to the large scale wargames at the Naval War College as the basis for major fleet exercises, laying the foundations for its future lead in carrier design and doctrine.

This allowed the U.S. Navy to develop a doctrine based on the assumption that air groups were most effective when used “*en masse*” and that carriers should operate independently from the battle line, having as its primary mission the destruction of enemy carriers<sup>18</sup>.

The wargames had in fact demonstrated the advantages of large, fast carriers, the ideal type suggested being a 39.000 tons ship capable of 35 knots, and were instrumental in the decision to use the very large and fast hulls of the *Lexington* class battlecruisers then being built for conversion to carriers. Other consequences were the decision to include a large fighter component in the air group and the early realization of the importance of the dive bomber as an anti-ship weapon. The balanced nature of U.S. Carrier Air Groups from the 30s was a direct result of College wargames, as opposed to an expected primacy of scout and

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<sup>16</sup> All major navies retired their pre-dreadnought battleships, but Britain retired a large number of Dreadnoughts and battle cruisers, downsizing their fleet and renouncing their former dominant position.

<sup>17</sup> Largely due to Fisher’s views, in a clear demonstration of the danger of excessive centralization.

<sup>18</sup> Battleships remained extremely difficult to destroy by air attack, since penetrating their deck armor required heavy A.P. bombs at high terminal velocity. Early dive bombers could hit them, but with too light bombs at too slow speeds, and level bombers could carry heavy bombs, but couldn’t hit moving targets. Lightweight airborne torpedoes weren’t expected to be able to penetrate underwater protections designed for heavyweight torpedoes and would have to rely on multiple hits. Battleships remained, therefore, an essential weapon for most navies. Wartime experience would demonstrate that torpedoes were more effective than expected and that more powerful dive bombers could carry heavy A.P. bombs.

bomber aircraft, the Board of Aeronautics having initially suggested to have only one type of aircraft, a bomber, before being confronted with the College analysis of wargames lessons (Miller, 2001).

The games also helped to set the focus of the Air Groups missions, demonstrating that direct attacks against the Japanese industrial base were beyond the capabilities of carrier aircraft, and would have to be performed by heavy land based bombers, thereby concentrating production of offensive aircraft on dedicated anti-ship weapons such as dive and torpedo bombers and validating the U.S. development of very long range ground based “strategic” bombers.

The emphasis on the air group and ease of air operations, with an early and vital understanding that what really counts is not just the size of an air group, but the number of sorties it can sustain<sup>19</sup>, that was at the center of U.S. carrier design was therefore made possible by the early intellectual exercises on the game board, followed by fleet exercises, and was to culminate in the superlative *Essex* class carriers of world war two. It should be noted that the first U. S. carrier to be designed as such, *USS Ranger* (Figure 7) displaced only 180 tons per aircraft, while the converted *Lexington* displaced 450 and the later British *Ark Royal* 360, the Japanese *Soryu* coming closer with 260 tons *per* operational<sup>20</sup> aircraft (Chesneau, 1992). Unlike the U.S. and Japanese navies, the Royal Navy was to adopt the idea that carriers wouldn’t be able to counter land based aircraft, regarded as inevitably superior to naval types, and choose to design their carriers to survive air attack rather than counter it, leading to the *HMS Illustrious* even worse ratio of nearly 700 tons per aircraft.



**Figure 7 – The USS Ranger, the first U.S. purpose built carrier, shows the U.S. Navy early emphasis on a large air group and an (semi) open hangar for ease of air operations<sup>21</sup>.**

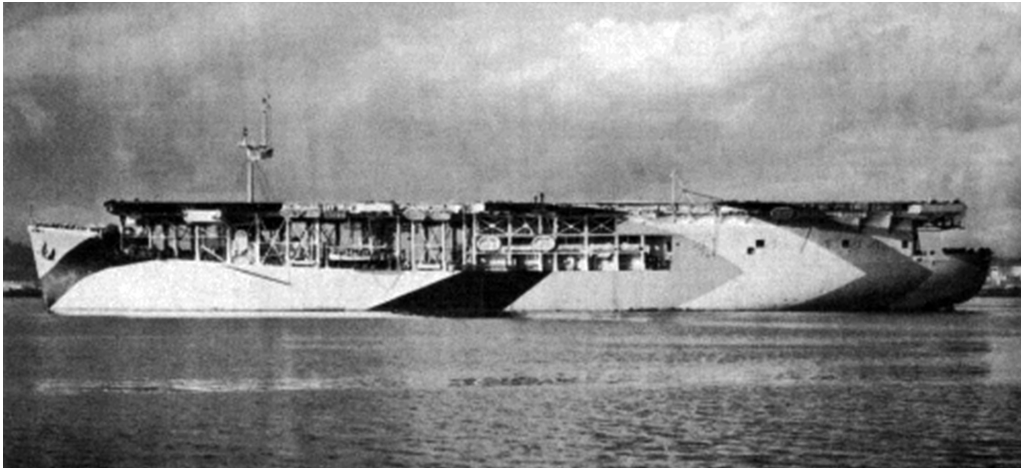
Source: [http://historywarsweapons.com/wpcontent/uploads/2013/05/USS\\_Ranger\\_CV-4.jpg](http://historywarsweapons.com/wpcontent/uploads/2013/05/USS_Ranger_CV-4.jpg).

<sup>19</sup> At Midway the Imperial Japanese Navy had a 4 to 3 advantage in carriers, but near parity in carrier aircraft 248 vs 233, and the greater ability of the U.S. Navy to deploy their aircraft would prove critical (Grumberg, 2016).

<sup>20</sup> Japanese carriers carried “reserve” aircraft that were intended as replacements and not ready for immediate operational use, a factor that must always been taken into account when comparing relative air strength. *Soryu* carried 63 operational aircraft plus 9 reserves.

<sup>21</sup> Allowing aircraft engines to be warmed up in the hangar.

Games also provided opportunities for some innovative ideas. In a 1929 wargame based on Plan Orange (the war plan against Japan) the Blue (U.S. Navy) team was faced with the need to overcome a possible Japanese local superiority in the Philippines and the students suggested a rapid conversion of eight merchant warships to auxiliary aircraft carriers (Figure 8), therefore allowing air superiority to be gained, an idea that was to be adopted in World War Two with the introduction of the Escort Carrier (Miller, 2001).



**Figure 8 – The USS Long Island CVE, the first USN escort carrier. Commissioned before the U.S. entry in the war, it was a contemporary of the British HMS Audacity but a more capable design. The escort carrier was an example of a concept born on the wargame and turned into operational reality**

Source: [http://navypedia.org/ships/usa/us\\_cv\\_long\\_island.htm](http://navypedia.org/ships/usa/us_cv_long_island.htm).

In carriers development the U.S. Navy seems to have been, as with battleships, in advance of its major rivals (in the case of carriers this meant only the British and Japanese navies, no other nation having a relevant carrier force; Figure 9). The British concept of regarding land based aircraft, not other carriers, as the major threat, led to extremely well protected carriers with a very limited striking power for their size<sup>22</sup> and the Japanese carriers, despite being able to match and even surpass the North Americans at the start of the war, mostly thanks to their crews extensive five year combat experience against China, failed to anticipate as well as the Americans the need for sustainability<sup>23</sup> and flexibility in air operations, needs that had been made apparent in successive and extensive Naval War College wargames.

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<sup>22</sup> The Royal Navy assumed that naval fighters would be inferior in capability and numbers to land based fighters and their carriers were expected to keep their aircraft locked in armored hangars and absorb battle damage while defending themselves with heavy AA guns. A decision to use two seat fighter further compounded the RN inability to gain even local air superiority. These are prime examples of a bureaucratic rather than academic decision making process.

<sup>23</sup> Underway replenishments were first used in 1933 wargames, six years before they were operationally tested by the fleet (Miller, 2001).



**Figure 9 – Aircraft being prepared for a mission aboard USS Yorktown, the second of the Essex class carriers. The real superiority of U.S. Carriers was below the flight deck, with open hangars that had excellent working conditions and allowed aircraft engines to be warmed up, allowing the carriers to generate a much greater number of sorties than other navies' carriers**

Source: [http://pwencycl.kgbudge.com/images/E/s/Essex\\_class\\_\\_hangar\\_full.jpg](http://pwencycl.kgbudge.com/images/E/s/Essex_class__hangar_full.jpg).

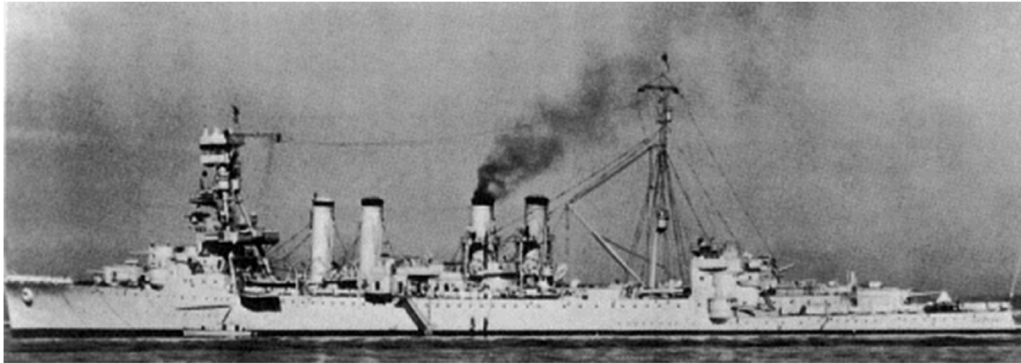
## 5. Cruiser development

U.S. cruiser development before 1914 had tended to the opposite extremes of large armored cruisers of near capital ship status (the “Big Ten of the *Pennsylvania* and *Tennessee* classes) and “peace cruisers” that were actually large gunboats, like the *Denver* class (Friedman, 1984). The need for dedicated scouting cruisers was emphasized in the 1902 and 1903 fleet exercises, backed by Naval War College studies (Friedman, 1984), and the first three scout cruisers were authorized in January 1904, the essentially experimental *Chester* class. Congress then refused to authorize any more scouting cruisers and the U.S. Navy entered the war having a powerful battle fleet but seriously lacking in light cruisers. It was only with the “preparedness act” of 1915 that allowed plans for a navy “second to none” that the possibility of building a large scouting force of light cruisers was authorized.

The Naval War College had been preparing for that moment since 1910, when, acting in its capacity as a “think tank” it had been asked by the General Board to suggest scout cruiser characteristics as a design basis in a classic case of the academics acting as pathfinders for the technocrats. The college had been using (nonexistent) scouts in their games and it was from conclusions drawn from these that the Board identified the primary requisites as speed, (at least 26 knots), endurance (at least 8.000 NM) and the firepower to defeat destroyer

attacks (six to ten 5 inch/51 caliber guns). More exercises lead to evolving requirements, the Board finally approving the decision to build two types of cruisers, a dedicated scout type, to be built to “large destroyer standards”, and a battle cruiser, intended to break through the enemy fleets screening forces, and closer to the unbuilt 1930s “cruiser killer” concepts than to pure battlecruisers. The lighter ships would become the *Omaha* class, while the larger ones, the *Lexington* class, would not be completed as designed, two of them being converted to carriers.

The *Omaha* class cruisers (Figure 10) are a good example of ships designed from an academic “clean sheet of paper” approach rather than the conventional incremental progress path. Very fast for their time at 35 knots, their guns were arranged to provide maximum “on end” firepower and to allow space for operating seaplanes. In service the ships would prove to be of somewhat limited value, being well adapted to their designed mission but not intended as multirole vessels. They had, in fact, been designed for use in Plan Black and not for use in Plan Red or Orange.



**Figure 10 – Concord, an Omaha class light cruiser. An advanced design when ordered, they were rapidly overtaken by cruiser evolution in the 1920s**

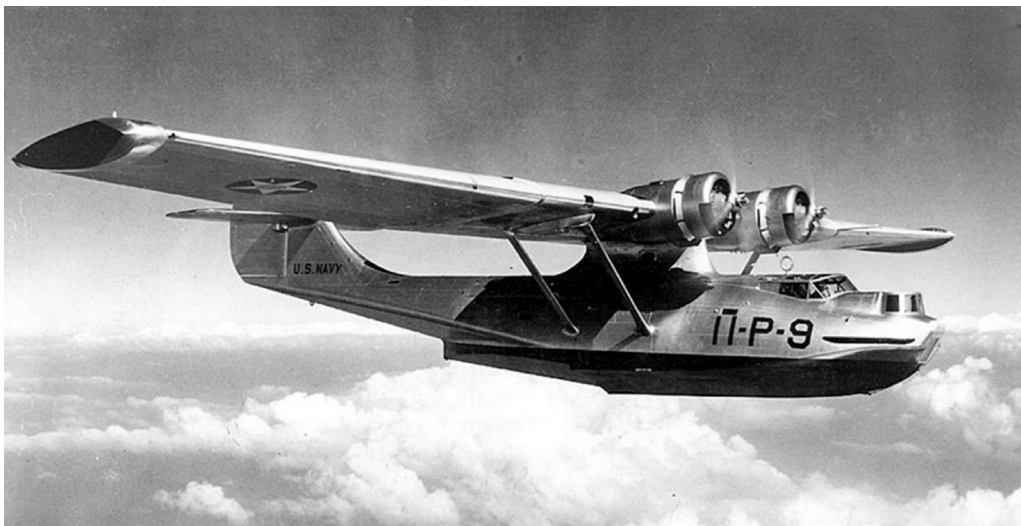
Source: [http://navypedia.org/ships/usa/us\\_cr\\_omaha.htm](http://navypedia.org/ships/usa/us_cr_omaha.htm).

Cruiser design was to be dramatically affected by the Washington Naval Treaty in two ways. The most obvious one was that, in a treaty meant to limit capital ships, it was necessary to define a lower limit for what was a battlecruiser or battleship in terms of size and armament, this being set at 10.000 tons standard and ten 8 inch guns, this limit consequently becoming the maximum limit for cruisers. This was based on the British *Hawkins* class of 9750 tons normal<sup>24</sup> and armed with 7,5 inch guns, but also on U.S. studies

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<sup>24</sup> Roughly equivalent to 9000 tons standard, normal tonnage included fuel and other stores not included on standard tonnage. They were unusual ships, the normal cruisers of WW1 were 5000 tons ships with 6 inch guns, since they had been design expressly for hunting down commerce raiders. WW1 had demonstrated that using cruisers against battlecruisers was suicidal, making armored cruisers obsolete and heavy cruisers of limited interest.

for an ideal cruiser that had already indicated that 10.000 tons would be required for their needs (Friedman, 1984). The second was that with battlecruisers and armored cruisers now almost out of the picture<sup>25</sup> the missions they had been designed for would now be given to cruisers, necessitating a new type of “heavy cruisers”. Once one Navy built one to the new limit, others would have to follow, the maximum limit becoming the new international standard<sup>26</sup>. The US concentrated on heavy cruisers after the treaty, not building any more dedicated scout cruisers, the *Brooklyn* class being classed as light by virtue of their six inch guns, but having fifteen of them in five triple turrets they were the size of, and better protected than most, treaty cruisers. It must be considered that the U.S. Navy relied heavily on aircraft for scouting, the *New Orleans* Class cruisers carrying four scouting sea planes and the Navy investing heavily on flying boats (Figure 11).



**Figure 11 – Both the USN and the IJN invested heavily on the flying boat as a Maritime Patrol Aircraft. Consequently they partly assumed the scouting role formerly assigned to light cruisers, the IJN light cruisers reverting to the Destroyer Flotilla Leader role, the adoption of 24 inch (Type 93) Torpedo Tubes giving them much greater fighting power**

Source: <http://www.gentlemenswatch.com/wp-content/uploads/2014/09/39381.jpg>.

<sup>25</sup> The British retained only three in the long term (*Hood*, *Renown* and *Revenge*, of which *Hood* was regarded as a fast battleship more than a battlecruiser) and the Japanese four (the *Kongos*) that were converted to fast battleships and deployed as such. The Germans were of course gone, having been scuttled at Scapa Flow, apart from the *Goeben*, retained by the Turkish navy as the *Yavuz Sultan Selim*.

<sup>26</sup> Nothing seem to make a ship type as desirable as a treaty definition. When the London Naval Treaty created an upper limit for torpedo boats of 600 tons to allow destroyer numbers to be restricted, a number of navies immediately started building 600 tons torpedo boats, that promptly proved to be too big to be coastal torpedo boats and too small to be oceanic ones, even nations, such as France and Italy, that hadn't signed the treaty (Whitley, 2002). Once again, as with cruisers, it was only possible to build balanced ships by making them bigger.

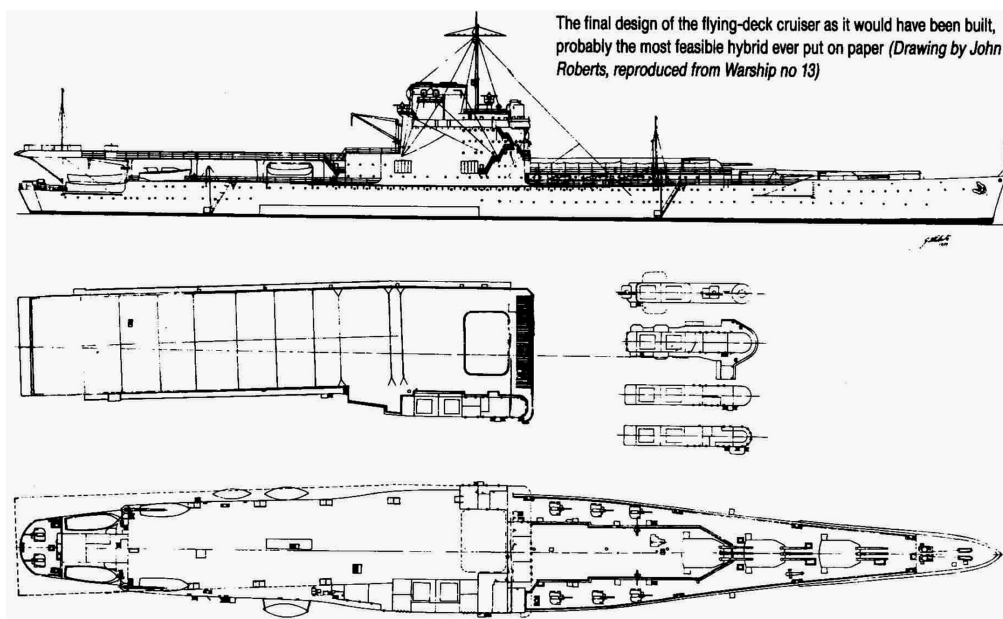
The challenge of designing a cruiser with all the desired attributes, that for the U.S. Navy were, in that order, speed and range, followed by firepower and protection (Friedman, 1984), was to prove technically difficult and it was handled mostly within the Board, based on pre treaty studies that were themselves based on College wargames. No country managed to design a well-balanced cruiser under the limit, with the possible exception of the French *Algérie* (Whitley, 1996), the Italians and the Japanese solving the problem by cheating, building superior ships (all Japanese 8 inch cruisers and the Italian *Zara* class) that were close to 12.000 tons standard (Whitley, 1996). Heavy cruisers designed after the treaty limitations were no longer in effect were all to be close to 15.000 tons (Friedman, 1984). (The U.S. Navy did build one final 10.000 tons heavy cruiser, the *Wichita*, using a modified *Brooklyn* class light cruiser design that was regarded as a very successful ship).

One question that generated a lot of debate was the desirability of having torpedo tubes on cruisers, the Naval War College being asked to evaluate their use in wargames and concluding that they had at best a 50% chance of being used in fleet actions, and less on other operations. The U.S. consequently underestimated the importance of torpedoes in cruisers actions, a mistake that was to cost them dearly in 1942/43 actions against the Japanese Navy (The USN was to lose seven cruisers in surface actions during the whole war, while the IJN lost five (Whitley, 1996). This probably came from failing to take into account the possibilities of longer ranged and more powerful torpedoes, such as the Japanese Type 93 torpedo. (Ireland, 1997). The type 93 61cm (24 inch) torpedo, was a major advance, being faster (it could be set to run at up to 50 knots), stealthier (it used oxygen rather than compressed air and left no wake), longer ranged (up to 40.000m) and more destructive (780kg charge), but was not the first attempt at a “bigger better” torpedo. The German Navy had introduced a 60 cm (23.6”) Torpedo in WW1, the H8 model, and the Royal Navy used a 62,2cm (24,5 inch) torpedo on the *Nelson* class battleships’ that run on oxygen enriched air (HMS *Rodney* torpedoed *Bismarck* with one of this, the only known case in which a battleship torpedoed another). Like the Zero fighter, the Type 93 was an American intelligence failure to properly evaluate Japanese advances in weapon development.

The College was heavily involved in the debate regarding the possibility of a cruiser/ carrier hybrid<sup>27</sup> (Figure 12) that started with the negations that led to the 1930 London Naval Treaty, and wargames indicated that it would be a useful type for scouting, screening and trade protection missions, the College regarding it as a very useful type, but the Board eventually rejected it in favor of pure cruiser and carrier designs (Friedman, 1984).

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<sup>27</sup> The Biplanes used at the time required very short flying decks. The Japanese did build an alternative concept of Seaplane Carrier/Cruiser hybrid. It can be argued that the German carrier *Graf Zeppelin*, with its small air group and heavy gun armament, was a variant on the carrier/cruiser theme despite having a full flight deck.



**Figure 12 - The projected Cruiser 39, a cruiser/carrier hybrid. A dead end in the 30s, the resemblance with the much later soviet Kiev class is interesting, with, of course, missiles replacing guns in the soviet design**

Source: [http://s49.photobucket.com/user/CanisD/media/Never\\_Weres/Raw\\_Drawings/USA/Carriers/USCruiser.jpg.html](http://s49.photobucket.com/user/CanisD/media/Never_Weres/Raw_Drawings/USA/Carriers/USCruiser.jpg.html).

It was also asked by the board to study the comparative merits of heavier 8 inch guns versus faster firing 6 inch guns, the College regarding the advantages of the heavier gun at long range as more important and recommending the heavier gun. The College regarded the later, better protected U.S. 8 inch cruisers as the best option (Figure 13), and concluded that the individual fighting strength of each ship was more important than numbers, but that was to be negated by the limits imposed by the London Naval Treaty against the U.S. Navy wishes. This view was to be reflected on the U.S. insistence during WW2 in building heavy cruisers with 8 inch guns, a concept that was abandoned by the other major navies. The College was also to exercise a positive influence by strongly advocating that cruisers should retain a heavy AA battery, strongly opposing a plan to restrict cruisers AA to the new 1.1 inch automatic gun (Friedman, 1984). U.S. cruisers were to do very well against aircraft, only one being lost to aircraft attack, against ten for Britain and twenty for Japan.



**Figure 13 – The New Orleans class were the final version of the U.S. “Treaty” cruisers to be built in numbers. Like all Treaty cruisers they were a compromised design, the U.S. Navy renouncing torpedo armament but adopting a powerful AA battery. Three of the class Vincennes, Quincy and Astoria were sunk by gunfire and torpedoes of Japanese heavy cruisers in a single battle (Savo island) during the Guadalcanal campaign**

*Source:* [http://navypedia.org/ships/usa/us\\_cr\\_new\\_orleans.htm](http://navypedia.org/ships/usa/us_cr_new_orleans.htm).

The College was not as influential on cruiser design as on battleships and carriers, and if the U.S. eventually built what are regarded as the best cruiser designs of WW2 (the *Baltimore* CAs and *Cleveland* CLs) (Whitley, 1996) that happened more as a result of an incremental evolution process. This was mostly a consequence of a Mahanesque U.S. Navy concentration on capital ships until WW1 that reduced experience on cruiser design, and to the limitations of the Washington Naval Treaty from 1922 and London Naval Treaty from 1930 that centered the cruiser issues on technical questions resulting from a fixed tonnage and caliber limit. The greatest College failure was its inability to foresee the intensive use of torpedoes and of the value of the greater rate of fire of 6 inch guns in the naval battles of the Solomon’s (Stille, 2013) during the Guadalcanal campaign, but it must be noted that other navies also reached the same conclusion that on long range gun actions the danger of damage from a cruisers own torpedoes exploding outweighed the probability of using them successfully<sup>28</sup>, and that the Solomon’s campaign was very unusual, since it was a prolonged campaign in closed waters with most actions being fought at night after both navies carrier forces had been severely mauled.

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<sup>28</sup> The *Zaras*, designed for long range gun actions, lacked torpedoes. Ironically three of the class were to be “executed” at short range by British battleships with 15 inch guns, an action at which a torpedo salvo would have been their only hope of fighting back.

## 6. A Navy second to none

That the U.S. Navy should become the world's most powerful seems obvious with hindsight, given the twin advantages of Geography and Economical power. But it must be remembered that until the very end of the XIX century, the Navy had been limited by doctrine and politics. It benefited vastly from having a superb propagandist in the person of Alfred Thayer Mahan, and a powerful advocate in the person of Theodore Roosevelt (Figure 14), who, both as Secretary of the Navy and later as President, implemented ambitious plans for naval expansion.



Figure 14 - A contemporary caricature of Roosevelt's use of the U.S. Navy as the "Big Stick" for imposing U.S. policy.

Source: [https://en.wikipedia.org/wiki/Theodore\\_Roosevelt#/media/File:Roosevelt\\_monroe\\_Doctrine\\_cartoon.jpg](https://en.wikipedia.org/wiki/Theodore_Roosevelt#/media/File:Roosevelt_monroe_Doctrine_cartoon.jpg)

From the influence of two such powerful personalities, it was almost inevitable that the Navy was at first unbalanced, with a very strong battle fleet, but with a cruiser force that had large armored cruisers and little else (With the exception of a strong and early interest on submarine warfare). The great leap forward was to come in 1915, with the decision to build a navy second to none, an ambition that would have been achieved by the post war building programs but that was made reality when Britain decided to avoid the cost of a naval race and conceded parity at the Washington Naval Treaty.

That the new navy that was now formally tied with the British as world's most powerful was not only big, but was also well balanced, technically advanced and displayed none of the growing pains often associated with rapidly expanding military forces is a direct result of its willingness to use the Naval War College as a part of its decision making process.

The College was essentially involved with the development of large warships. The advanced U.S. anti-submarine warfare programs of both world wars were to be mainly the result of concepts developed by OPNAV (Friedman, 1987), such as the Eagle boats of 1918, forerunners of the corvettes that were to win the battle of the Atlantic in World War Two. This can be seen as the consequence of progress in ASW being technologically driven, or as an indication of the Mahan legacy of the College concentrating on Fleet actions.

The General Board was also the leading force regarding destroyer development<sup>29</sup>, the rapid evolution of the U.S. Navy destroyer force (Figure 15) (reaching the impressive total of 319 in the early 1920s reduced to a more reasonable 161 by 1926 (Friedman, 2004)) being another case of improving technology driving the design process, the evolution of U.S. submarines following a similar pattern, the U.S. Navy not being averse to cooperating with civilian entities, for example working with the railway industry to develop diesels for submarines (Gardiner, 1992).



**Figure 15 - This image of eight Wickes class destroyers, of the flush decker type, being built at New York Shipbuilding Corporation, Camden, New Jersey in 1919 illustrates the “quantity as a quality of its own” nature of the U.S. WW1 destroyer building program. Not an outstanding design, their availability in large numbers for conversion to oceanic escorts were to make them a vital weapon in the battle of the Atlantic in WW2.**

Source: [https://en.wikipedia.org/wiki/Wickes-class\\_destroyer#/media/File:Camden\\_Shipyard\\_1919.jpg](https://en.wikipedia.org/wiki/Wickes-class_destroyer#/media/File:Camden_Shipyard_1919.jpg)

## Conclusions

The better results of the “think tank” approach on battleships and carriers as opposed to cruisers seem to indicate that an academic centered process works better when dealing with

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<sup>29</sup> Which might be the reason why the flushdeckers were outdated even when they were first commissioned in 1918 (Whitley, 2002)

new (carriers) and unrestricted (pre treaty battleships) areas of development, the existence of either extensive experience (as in the Royal Navy with cruisers) or of fixed limits (as in Treaty Cruisers) negating the main advantage of the academic approach, which is to formulate new requirements or to test alternative concepts in an open intellectual medium. An argument can also be presented that an academic institution can be vulnerable to dogma, in the College case Mahan's focus on battle fleet actions. It is also clear that the academic approach is at its best at times of rapid technological progress, as happened in the initial evolution of Dreadnought type battleships and with the introduction of carrier aviation.

The College was used by the U.S. Navy to inform its decisions in cases where there wasn't a clear, technologically driven path for progress. And it can be concluded that on such cases the College, with its approach based on collective and open discussion involving both its professors and students and those on positions of responsibility on the various technical boards<sup>30</sup>, combined with an intense use of wargames to test and evaluate concepts, allowed the U.S. Navy to introduce advanced concepts that were to be validated by war experience. The exercise proved mutually beneficial, the Navy getting better ships, and the College breaking away from its dogmatic Mahan inspired single minded focus on big ships and moving towards a more balanced Navy with strong scouting and screening forces, even though congress was slow to follow suit, and big ships were always easier to find a way into budgets.

In the areas where the college was involved the balance is therefore clearly positive, the U.S. Navy becoming a world leader in battleship and carrier design, and for a brief moment in cruiser design, while in other areas of warship design the Navy didn't show the same qualitative leap.

The main advantage of the College for warship designers was that it could provide a realistic prediction on how future battles would be fought, allowing warships to be designed for them as opposed to being designs for the last war. If we can discard oil replacing coal on battleships as a natural evolution imposed by practical considerations, the two great innovations of the dreadnought era, the single caliber battery and all or nothing protection both are a direct consequence of the College correctly anticipating that battles would be fought at much greater ranges. Similarly, it was the college ability to fight simulated carrier battles before the carriers were even built that allowed the U.S. Navy to be the first to understand the need for massed air power and to design carriers that could generate a much higher sortie rate than any others. It is this capability of thinking ahead of existing conditions that makes academic institutions powerful instruments for the development of armed forces, a capability that is most valuable when, as happens now, we are facing both rapidly evolving technologies and evolving threats. It must also be considered that today's digital simulation technology allows the use of conceptual weapon systems in wargames with a higher degree of realism.

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<sup>30</sup> Themselves often graduates of the Naval War College.

The practice of using military academic institutions at the War College level as think tanks seems, therefore, to have, in the case of the Naval War College, to have been validated by historic experience.

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