Succeeding in Periods of Abrupt Change[1] [2]

Overview

"The world you knew has disappeared and the future hasn't yet been written" seems a relentless alarm. Even before covid-19, what we do and how we do it seemed under attack by AI, digitalization, machine learning, globalization, industry 4.0, G5, genomics, and robotics. It won't end. Covid-19 adds its own disruptions of public health requirements, resource availability, market preferences, and political fortunes. Other pathogens are waiting their turns, and technologists haven't stopped being inventive.

Unfortunately, there aren't off-the-shelf examples to copy for dealing with abrupt technological change, intersecting with abrupt strategic change; analogies don't translate. However, even if we don't have known destinations nor courses charted to get there, there's history that shows how to navigate unfamiliar circumstances. First off, don't try to think your way to the right answer with some elitist brain trust being fed sacrificial reams of data. Precedents are too weak; *relevant* data is too sparse. Nevertheless, we can explore, experiment, and knowledge share to discover our way to the right answers. Our first best guesses may be far off. With feedback fast, frequent, and high fidelity enough, we'll converge quickly.

A pair wise case comparison that illustrates the "don't think, do" (don't deliberate, discover) point is how the US and Japanese Navy approached the strategic and technological unknowns of the late 1800s and early 1900s, in markedly different fashion. Those choices prepared the US to deliver devastating counterpunches in the first half of 1942, well before its industrial base could surge materiel into the breech.

True, the example starts more than a century ago and occurred at a scale and with cycle times beyond what most of us contend with. However, the behavioral patterns are there as examples for our own. First, when in doubt (and we should always be in doubt), expose ideas to fast, frequent and fierce challenge to find flaws in thinking before they become flaws in doing. Second, when searching for solutions, expand the experimental base so distributed experience feeds a shared wisdom far greater than the sum of the parts.

Application of those lessons to contemporary problems is given…including early stage drug development, creation of electronic devices over enterprise processes thousands of steps long, and restart of schools subject to covid conditions.

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[2] Trent Hone, Fellow at Excella and author of *Learning War*.

Same Problem: Two approaches

Summer 1942 should have been celebratory for the Imperial Japanese Navy (IJN). They'd surprise attacked in December '41 and immediately added victories—Guam, Singapore, Philippines. June 1942 was to be the coup de grace. A Japanese fleet was directed to Midway Island, to draw the US into a decisive battle. The US Navy (USN) would be without its battleships—those dreadnoughts essential to any mid 20th century navy's doctrine, the ruins of which still marked Pearl Harbor. Not only that, the Japanese fleet approached with more ships and sailors, more planes and pilots than the US, that disparity another 'guarantee' for decimating US aircraft carriers, meaning that Japan's Greater East Asia Co-Prosperity Sphere would be unchallengeable. One can imagine that the IJN even planned a celebratory parade in Tokyo for July 4th, to add insult to what should have been terrible injury.

That parade never happened. The US countered the attack, did devastating damage, sinking or otherwise crippling two-thirds of Japan's carrier fleet. Not blessed with regenerative might anywhere close to that of US industry, Japan was crippled. Though the remainder of the Pacific War was horrific by every measure of life limb and treasure, the IJN couldn't mount meaningful offensives. Theirs was a costly and ultimately pointless death spasm.

How is it that the US won, despite the disadvantages? When it comes to pinning a day and time when the IJN was surely beaten at Midway, there's due credit to broken code, giving the USN some alert that an attack was forthcoming. To be fair though, this cryptography was in an era with none of the imagery and locational technologies that we take for granted. US scouts would still have to find the IJN (which only happened after IJN planes had begun to pummel Midway). As far as those scouts, credit is fairly given to Navy pilots' heroics, often embodied in the person of Lieutenant Commander Wade McClusky, who altered his assigned search, persevered despite dwindling fuel levels to find IJN ships, and led an initial attack. One might even say that the pivotal moments were when the IJN fleet left ports around Tokyo, in a discombobulated manner.

However, *Shattered Sword* authors Jonathan Parshall and Anthony Tully write these obvious answers are actually wrong.[3] They contend that the IJN's fate was sealed no later than…1929! After recreating the battle from the IJN's perspective in minute detail—from the decision making in ships' bridges to the labor to re arm and refuel planes below decks, and ultimately the havoc and horror amidships when high pressure steam pipes burst and flames roared against

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[3] *Shattered Sword: The Untold Story of the Battle of Midway*, Parshall, Jonathan and Tully, Anthony, Potomic Books, 2005

bulkheads, they offer that much of the experiences the IJN in June 1942 were baked in by beliefs and assumptions that had hardened long before .

How so? According to *Shattered Sword*, the IJN's leadership deliberated in the late teens and early twenties how new technologies such as battleship dreadnoughts and aircraft carriers could be used to project power with new (trans-oceanic) strategic objectives, against new challengers (British and American).

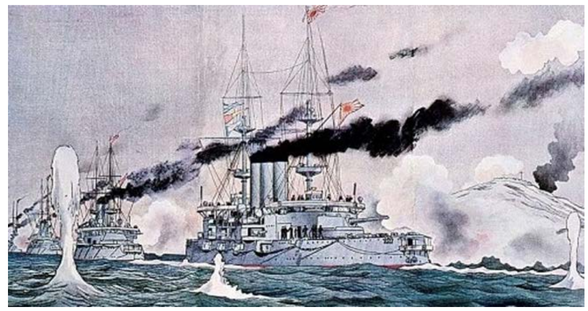


Figure 1: The Battle of Tsushima

By 1929, they'd locked into a doctrine of massive and devastating first strike. The idea was that a hard first punch would wreak an opponent's fleet and destroy that adversary's will to fight. This was a stretch extrapolation of the experience defeating the Russians in the early 1900s (though fighting Russia didn't mean contesting the entire Pacific, and the Russo-Japanese war occurred before the Wright Brothers invention had even been noticed, let alone advanced to the point of being a seaborne weapons platform).[4]

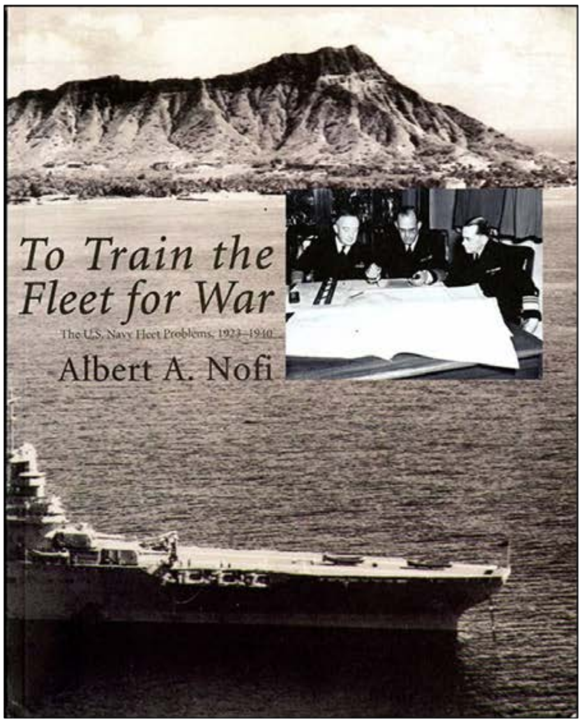
Despite those limitations, coming to such a definite conclusion must have felt great to all concerned. With senior leadership putting uncertainty aside, Japan could get to "the hard work" of designing and building ships and planes that subscribed to those doctrinal beliefs. Tactics and training could follow, with milestones established and progress measured. To show just how certain IJN leadership were in their decisions, Parshall and Tully describe war games conducted before Midway. With admirals on one side of a table sprinkled with small wooden model ships, and with junior officers as proxies for the USN on the table's other side, they began enacting their battle plan. Quickly, the referee interrupted, ostensibly because the proxies weren't following the written plan. Why not? The junior officers, not so attached to the plan, imagined that an outnumbered opponent might fight differently. (That the proxy's approach was winning was likely the real reason for the ref throwing a flag.) IJN leadership could have had a 'eureka' about flaws in their thinking, and they could have debriefed the proxies to learn from them. Instead, in slapstick fashion, they kept replacing one proxy with another, hoping for validation.

Perhaps, this feedback deaf, command and control approach would have been sufficient had the IJN conflicted with a Tayloristic enemy, who were also convinced that some small group of elites

[4] Image: https://www.historiarex.com/uploads/files/1437527918.jpg Japanese naval squadron steaming to bombard Port Arthur, Russo-Japanese War 1904-1905. Artist: Unknown

do the thinking and mindless masses doing the doing. But, they didn't. Instead, they collided with a learning-leadership oriented USN.

See, the US Navy's leaders faced a similar predicament as the IJN's coming out of WW I—not knowing how to project power across the ocean's expanse, using the new technologies that were becoming available, against new competitors. Whereas the IJN thought through the problem and _decided_ on a solution by 1929, the US Navy's leaders essentially admitted that they really had no good idea how to face the challenge.



Fleet Problems

I:	Defend the Panama Canal	1923
II-IV:	Simulate Pacific battles	1924
V:	Fight at Hawaii	1925
VI:	Move across Pacific to relieve Army garrison	1926
VII:	Attack/defend Panama Canal	1927
VIII:	Convoy search, anti-submarines	1928
IX:	Panama Canal	1929
X:	Surprise air attack	1930
XI:	Tactical exercises on fleet formations	1930
XII:	Amphibious landings	1931
XIII:	Invade enemy ports	1932
XIV:	West coast air attack	1933
XV:	Land and sea combined	1934
XVI:	Coordinated offensive over large areas	1935
XVII:	Task force battles	1936
XVIII:	Amphibious (Island hop Alaska and Hawaii)	1937
XIX:	Search tactics	1938
XX:	Defend East coast	1939
XXI:	Dispersed fleet (US) vs concentrated one (Japan)	1940
XXII:	Several proposals developed, not run	1941
XXII-XXVIII...		

Not that they gave up. Quite the contrary. Starting in 1923 and continuing every year for nearly two decades, the Navy ran a series of "Problems" (not exercises). For instance, if the Panama Canal is key for moving ships and supplies, how do you defend it from attack?[5] "Don't know" was the basic answer, so ships and sailors were sent to sea to test ideas, seeing what worked and what didn't. (To make clear differences in IJN and USN approaches, consider that in 1929, by when the IJN had decided its doctrine, the USN was running its _3rd_ Panama Canal problem.)

Replenishment at sea, defense and offence with submarines, coordinating with the Army, amphibious attack of island strongholds. These were all problems for which answers didn't exist,

[5] Please see: HM 18: *To Train the Fleet for War: The US Navy Fleet Problems, 1923-1940*, Albert A. Nofi, US Naval War College Digital Commons, 2010.

so experiments were run ashore at the Naval War College and elsewhere and at sea, from which lessons were drawn and added to an increasingly rich playbook.

Consider this example of the Navy's leadership gaining feedback fast and frequently. During exercises, the flag officers didn't retreat to the privacy of a wardroom to consider how well their subordinates had executed their superior's plans. Instead they debriefed publicly, on deck, with the officers who had been running the problems, so they could be told what was wrong with their thinking from those who had been doing the doing. If one of those "hot washes" had been re-created in a 1950s war picture, there'd have some wise mouthed Brooklynite spouting off with a "Yo. Admiral. What was youse guys thinking?" with a blond headed Minnesotan and a LatinX sailor from LA nodding their heads in condescending agreement."[6]

Solving Today's Problems

How does such an approach of finding flaws in thinking before the become flaws in doing apply today? First of all, it's easy to disparage the IJN leaders as arrogant elitists, too thin skinned to hear honest assessment. But, are we so different? Aren't we quick to assume <hope> we have a clear picture so we can get to the nitty gritty of building plans and executing against them? After all, who doesn't want the kinetic satisfaction of getting things done? And once we've invested in a plan, how much do we want to hear critique? If we really wanted to hear what's wrong, would we invest so much in giving presentations/reports with almost a sales-pitch tone? Don't we raise our hands in class to show off we've got the right answer, hardly ever (intentionally) to revealing how we got to the wrong one? It's natural to want to feel and look right.

That said, those who've gained comfort revealing their best thinking specifically to find out what's wrong with it have enjoyed huge rewards.

<u>Early stage new drug discovery</u>: Take Liz for example, a PhD organic chemist, responsible for a team of other brilliant chemists in the way upstream 'discovery' phase of inventing new medications. Liz started thinking that part of the reason it took so long and cost so much to get through every phase was that she and her team were taking a very IJN approach to testing new

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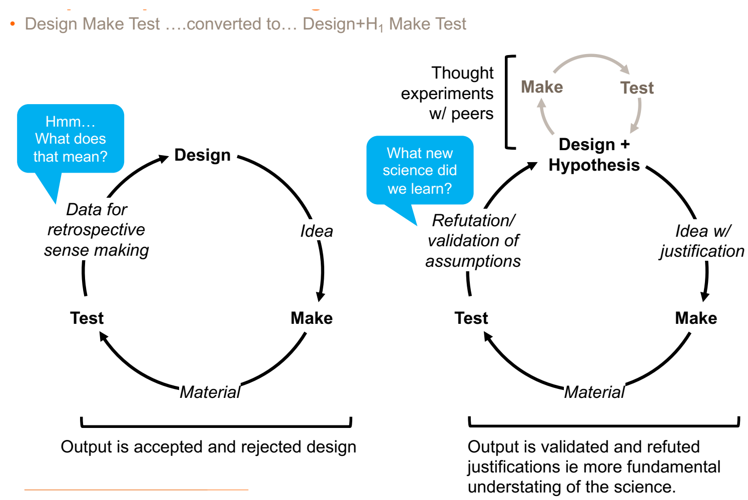
[6] After the war, Admiral Nimitz remarked, "Nothing that happened in the Pacific was strange or unexpected."[6] The relentless experimentation and openness to testing, trying, rejecting, and accepting new ideas at the Naval War College in Newport and on the high seas meant that everything the Japanese threw at the U.S. Navy had been anticipated in practice beforehand. (The exception to this pattern was the first kamikaze attack in the Battle of Leyte Gulf,1944.)

ideas. Someone'd have an idea for a new molecule and some notion of how to synthesize it. They might share their ideas at periodic meeting, but in such a way it was hard to poke and prod. They'd actually make the materials and run the samples through a series of lab-based tests, out of which there'd be a pile of data which then demanded retrospective sense making. In truth, testing was really filtering, sorting molecules that worked from those that didn't.

While unproductive, there was an emotionally safe element to it. You never had to show your colleagues your best thinking and have them start taking pot shots.

But protecting egos at the expense of delaying therapies didn't sit right, so Liz decided to try being more like the USN in approach. They adopted a simple rule: if you had a new design, you couldn't jump right to testing it. First, you had to explain your beliefs (best guesses maybe) about how it would behave in the lab and why. Then, when ideas were shared in chemists meeting, colleagues could do the thought experiments as to how well the hypotheses would play in practice. Right there, there were 'free' learning cycles without burning any lab time. Then, once an improved molecule (with improved thinking attached) was actually made and tested, the data was much more valuable—validating and refuting the justifications that had been worked out.



This might seem a simple change: from "here's my design" to "here's my design and it's justification. Now, take your best shots." But what a HUGE change in outcome. A process that normally took a year or more got done in six months. And what normally took 60 of these design-make-test cycles took fewer than 20. To put this in context—a therapeutic 1st or 2nd to market is worth 100s of thousands for every extra day under patent protection, whereas one arriving later is worth less, and once patent protection runs out—basically zip. Liz and her team had shown how to win back six months in their portion of creating new drugs

<u>Large scale capital projects</u>: "Win at Midway" is not just an appropriate cheer for big brain chemists. Walter Marshall was running a huge civil engineering project, one slated to take years and cost up to a billion dollars. You can imagine then, the exhausting detailing of plans and protocols he and his team were doing before the launch, wanting to make they dotted every "i",

crossed very "t", and not missed a single instance of "i" before "e"…. Then, Marshall realized he was taking an IJN approach—the senior leaders thinking hard to get to the right answer, that they could then show off to their bosses in hopes for a thumbs up and pat on the back. And how'd that work out for Admiral Yamamoto? So, Marshall called a T. He pulled some 60 other superintendents, deputy and assistant superintendents into a huge meeting room one afternoon—probably about 100 people, with each stage of his plan taped to the wall.

They might have thought Marshall and his core team had really beavered away to the final plan, and this was the big reveal. Instead, they walked in to find the plan in its many increments and modules plastering the meeting room walls. After only a brief introduction of the basic flow and underlying ideas, Marshall then said, "Alright. Start taking your best shots."

You can imagine, at first, there was a little hesitation, but then the flood gates opened. "Yo, Marshall. You have <that heavy thing> resting on a stand. We discovered there's more compression in those than you've accounted for, and that little bit'll mess up the alignment for some of your utilities and all that." "Yo, Marshall, you've got a couple of different trades all working in that particular area. We found out there's a lot of coordination needed amongst those folks to really fine tune their work sequence. You'd better get them to huddle soon to work that out, or they'll be bumping into each other."

It was four hours of "Yo, Marshall <this>" "Yo, Marshall <that>." The payoff was enormous. In exchange for 400 working hours, just the first phase of worksite prep won back three weeks out of what was anticipated to be three months of efforts by 100s of employees. The payback on the initial time invested was hundreds:1, and that was just in the first phase.

<u>DevOps, IT and Agile</u>: "Win at Midway" by getting feedback early and often is the essence of the IT community's "agile" development, an approach to developing new systems that is the antithesis of an IJN approach. It used to be, some team would develop a production schedule for new software, projects running months, if not years, and—whatever the baseline cost—they always cost way more. Why such consistent disappointment? Because the initial schedule was at best a wild guess—it was new software, meant for new machines, providing new functionality. No one really knew what it really would be or how to actually make it. So the schedule was a wild guess and insisting on adherence to it was mad.

So, what'd the agile folks do? Create an approach with rapid sprints to the first chance for feedback (minimally viable product) followed quickly by a huddle or scrum to figure out what was wrong with what they'd shown potential users and what was wrong with how they even got there. Informed by feedback from the first sprint to the first MVP, it was sprint again to the second third and fourth.

Enterprise Spanning Business Processes: DigiTech, an electronics manufacturer, has enterprise wide processes—early stage development and market research, design and debugging, sales, fabrication, installation and service—that span hundreds to sometimes thousands of steps, and encompass the work of hundreds of people. Of course, as is often the case, no one actually knew the full scope of these processes. Sure, somewhere an industrial engineer might have a protocol, but work actually progressed as people in one function worked on a project, eventually handing it to those in other functions. Once the project arrived, it might have fallen into a queue, with folks in the new function having to determine what needed to be done, doing substantial rework before they could be started. Predictably, when a program veered off course, someone senior would play flight controller. The program might get back on track, but not well enough to restore the time, cost, and quality that were the initial requirements.

Mary saw this couldn't continue. She and her colleagues started mapping out the process, giving as best a visualization of how work actually progressed. This immediately revealed gaps…people recognizing on whom for what they depended and who depended on them for what also. With a baseline articulation in place, the DigiTech engineers could start taking shots at what seemed to be going on—like Liz's organic chemists or Marshall's engineers and skilled trades people. The thought experiments started to reveal insights. Then, once they started doing work according to the maps, they could early and often see what was misunderstood and what simply didn't work. They were running 'problems' in the spirit of the USN circa 1920s.

Gestating a Learning Culture

You might be thinking, how did US Navy leadership arrive at such an enlightened view of leadership—experimental rather than dictatorial, distributed rather than centralized? Think of the context. Frederick Taylor only a few decades prior had popularized scientific management. His attitude about labor was wildly undemocratic, with managers doing the thinking and then *enforcing* standards on their subordinates.

The Navy's culture (or counterculture given what we just observed), so important in the 20s and 30s, leading into the 40s, seems to have gestated in the late 1890s spilling into the early 1900s.

That period was challenging. The early to mid 1800s were framed in terms of Manifest Destiny and continental expansion—Louisiana Purchase, Lewis and Clark, the 1849 gold rush. By the end of the 1800s, that possibility was well-explored with 45 of the 48 continental states already part of the Union (and the other few were already territories). The US was thinking of itself not only as a continental entity but as a trans-oceanic one too. For the Navy that meant thinking of itself as tasked with coastal defense. It had to imagine itself as projecting power and protecting interests across the Atlantic and with even greater difficulty across the Pacific. After all, Japan was having expansive aspirations. US power projection might well be contested.

Strategic re alignment wasn't the only concern. Nautical technology was going through a huge evolution. Hulls could support larger weapons, weapons had greater range and accuracy, and power plants could get ships on location faster than ever before. These advantages were all just potential though, unless someone figured out how to maneuver and fire effectively.[7]

As an example of this step change, when the *USS Texas* came on-line, she certainly was different in important ways from her predecessors of 100 years prior—steel hull versus wood, fuel burning power plant rather than sails. However, with her side mounted guns, she had much in common tactically with the Men of War that had cruised in the centuries prior. Admiral Nelson might well have been comfortable commanding her as part of a larger fleet.

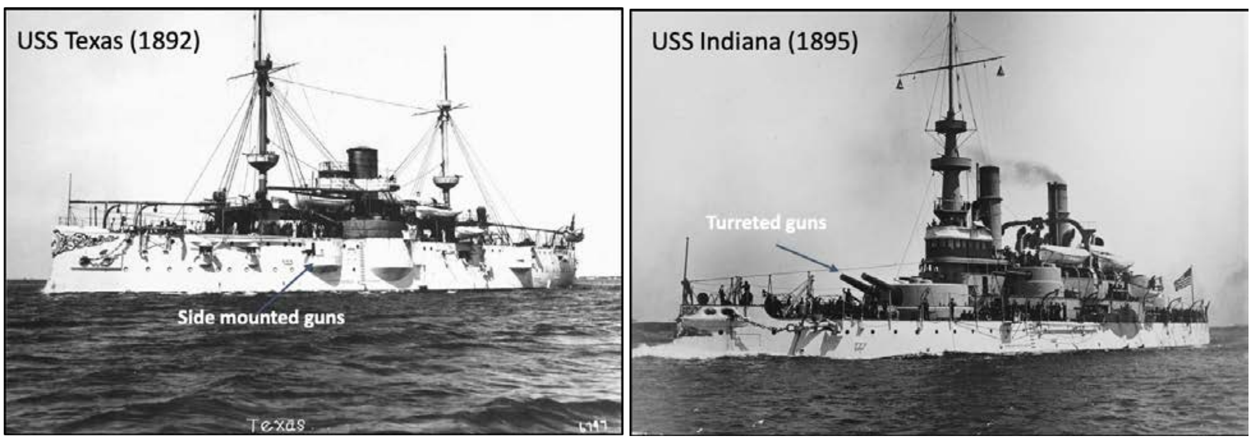
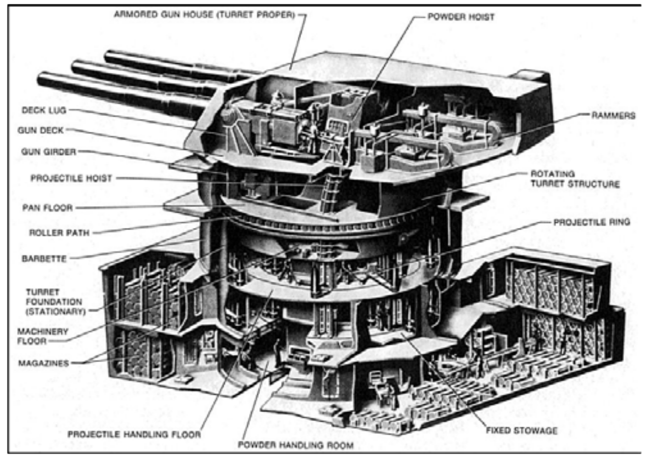


Figure 2: From Man o War to Dreadnought

Nelson might well have been flummoxed, at first at least, by the *Indiana* birthed just three years after *Texas*. Her turret mounted guns gave her discretion to fire at much greater range, simultaneously at multiple targets. That introduced more tactical variables to consider when skippering the ship, and then there was the technical complexity of the turret and its guns.

[7] Image source: http://www.ibiblio.org/hyperwar/USN/GSBO/GSBO-10.html



This put the Navy's leadership in a real predicament as they had to figure out new strategy, new tactics, and new technology.

If one had to guess what they would do, it would be reasonable to assume they would adopt a command and control approach. Theirs was an era of status, hierarchy, authority and discretion given to a select few based on race, sex, religion, and lineage. Normal then would be to assign the problem to some dedicated team of 'experts,' have them determine solutions, and then have solutions assigned to ships to be followed compliantly. That's what other navies did.

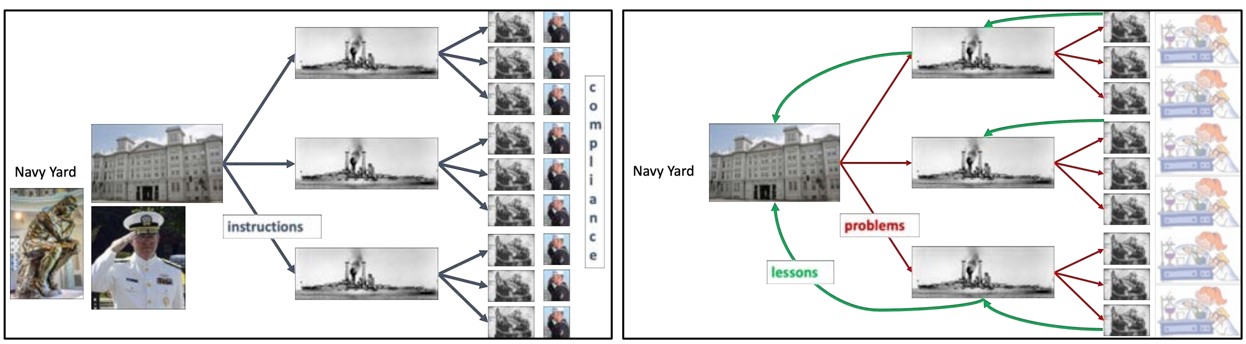


Figure 3: Command-control vs. distributed experimentation

But not the US Navy. The turn of the century leadership admitted they had no answer. So, ships' commanders and crews were allowed to experiment with new technologies with different approaches in contests of different types. Many alternatives could be explored simultaneously, and situational nuance could emerge. Local experimentation coupled with mechanisms for knowledge capture and knowledge sharing allowed the Navy as a whole to synthesize collective wisdom greater than any one part.

Making iterative experimental learning the norm

A starting problem was pretty basic: how does *Indiana* and others like her hit targets?[8] At Manila Bay and Santiago, as reference, hit rates were one to two percent. The Royal Navy had introduced the idea of continuous aim; rather than fix the guns' pitch and waiting for the deck to roll onto target, crews would continually adjust to stay on target. Doing so offered the chance of firing at any moment, not just during a roll down or up.

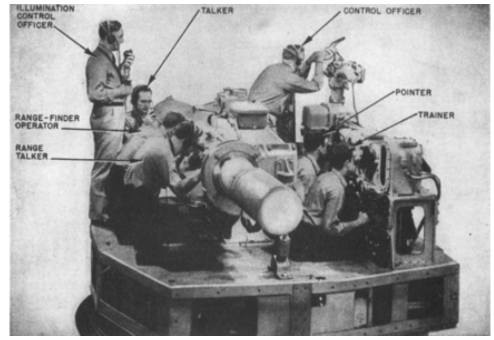


Figure 4: The Mark 37 director. Mounted atop the pilot house on a steel cylinder 9 feet in diameter, the director operated with a staff of seven. (U.S. Navy)

While that might help with quantity, it didn't necessarily help with quality; that's where the experimentation came in. To promulgate mastery of the technique (so they might actually hit something), William Sims, a junior officer who'd gotten support for testing his ideas directly from President Teddy Roosevelt (former Assistant Secretary of the Navy) established target ranges, competitive practice, and—this is key—dissemination of lessons learned from failures and success during practice to advance the collective understanding.

Turret level experimentation revealed that ship wide coordination was inadequate. More experimentation led to 'fire control systems,' with someone aloft spotting targets and calling for corrections in aim. Experimentation around that revealed the need for and led to the creation of range finders and range projectors, substituting for visual judgement and manual calculation.

The point is, as experimentation was carried out to solve on problem, resolution led to realization of new ones to be addressed, giving great utility to this recursive use of distributed experimentation and shared knowledge synthetization. This behavior continued.

During the 2nd World War, the Navy had to deal with additional rounds of complexity. There was the complexity already onboard ships, and ships were slotting into larger task forces with more complex missions, and there was the flood of information coming aboard from radar and radio. The Navy's resolution of this ship level situational awareness problem was the Combat Information Center. The idea of the CIC was to provide a common place in which

Figure 5: Combat Information Center: Providing situational awareness external and internal operating relationships

[8] Image source: http://www.ibiblio.org/hyperwar/USN/GSBO/GSBO-10.html

information could be collected, consolidated, and displayed in standard fashion. As when facing previous rounds of novelty and innovation, the Navy reverted to form, allowing experimentation at the ship level to inform a synthesis of experiences that helped determine best designs and best uses.[9] [10]

Committed time and place for capturing lessons learned and improving best known approaches:

Distributed experimentation might have meant some great ships, several good, and a few poor (and similar heterogeneity at the task force level, coming out of fleet problems). However, the Navy established several mechanisms by which lessons learned from the distributed experimentation—lessons both from success and also from failure—could be consolidated and systematized, so an evolving best approach was available to all.

"Type commands" were created for destroyers, cruisers, battleships, etc. and later also included types of aircraft squadrons (patrol planes, fighters, torpedo bombers, etc.). Type commands held, in part, the official documentation and dissemination of effective procedures and practices particular to different units. The second knowledge base was in the fleet organization itself. This is where understanding specific to a 'type' was integrated to the needs of various commands. Destroyer squadrons, cruiser divisions, and fighter squadrons, for example, took the official material from the type commands, balanced it against their own experiences and ingenuity, and crafted contextual approaches. At a layer up, the US Naval War College, in Newport Rhode Island, helped structure the Fleet Problems in the 20s and 30s, developed the rules that governed them, and familiarized officers with a variety of important processes, like how to craft and frame orders. It also analyzed more hypothetical problems, those that couldn't be worked through in the fleet because of various constraints. The NWC could simulate a large Pacific Campaign over months, for example; the fleet could not.

Said with some dramatic flourish, these learning dynamics and structures were the Navy's 'secret weapons,' and they had been developed before war began. The Navy had created a culture in which senior leaders allowed their juniors the latitude to experiment and had created mechanisms for capturing lessons learned and returning them back to the force for further trial, refutation and validation. With culture and mechanisms in place, the Navy had a meaningful

[9] Advances in ship board CIC allowed CICs to be installed eventually at the Task Force level too, so there were layers of situational awareness.
[10] For more on Combat Information Centers, please see *Information at Sea* by Timothy Wolter, John Hopkins, 2013.

advantage over the IJN when it had to figure out what to do and how to do it under pressure. The Navy was getting more and better ideas and doing so with a decided speed advantage.[11] [12]

Distributing Experimentation Today

We're seeing now the benefits of distributing experimentation and rolling up lessons-learned and the costs of not doing so. Some school districts made sure principals and teachers understood the basics of infection prevention—masking, social distancing, ventilation, illness reporting, contact tracking, etc., and then allowed sites to test approaches in context. Sharing experiences fermented a best understanding of general approaches with allowance for local customizations. By and large, those systems are opening. Systems that took a centralized approach—the superintendent's staff developing 'policies' for principals and teachers, were slow to get on line in the Spring and are slow to re open this Fall. A key point: this is not just about resources. There're plenty of wealthy suburban districts who are having students distance learn this Fall while less affluent districts are establishing some normalcy despite resource scarcity.

A similar challenge is cresting over retailers, especially those previously dependent on the instore experience. One can confidently predict, that those who reignite an experimental approach like when "omnichannel" retailing was being conceived a decade ago, those'll arrive at novel and successful models. Those that have their affiliates hanging for corporate direction…they'll find themselves trying to catch up.

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[11] How learning was seen as a strategic differentiator is evident in how militaries managed warriors. Japanese pilots, though aces, were treated as consumable, with no rotation home. Their best got worn down by burnout and attrition and the quality of those in the pipeline steadily declined. Training and preparation periods were shortened, bad enough. The timeliness of the training grew increasingly out of date. In contrast, the USN rotated commanders—even successful ones in and out of theater. Why? In part that was to avoid burnout. In part it was to have those with the most current understanding of threats and responses inform the education and training of those in the pipeline.
A similar story is told about the management of British and German pilots during the Battle of Britain. Despite the onslaught the German air armada and what would seem to be obvious pressures to keep as many pilots active as possible, the Brits flew few hours per day and fewer days consecutively before they were taken out of rotation for recuperation. German pilots were subjected to a higher operating tempo for longer, uninterrupted periods.

[12] A retired senior submariner shared with me the counter example of Dudley Walker "Mush" Morton. Morton commanded the *USS Wahoo*, which was credited with sinking 19 Japanese ships during four Pacific patrols in 1943. This senior officer commented that Moore wasn't given much recuperation time between patrols—23 days in January, 42 in February and March, 26 in April. The stress and strain were apparently evident as his logs got increasingly illegible. The *USS Wahoo* was presumed lost in September 1943.