

## Air Power

# Symbiosis Between National Power Elements: An Air Power Focus

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The symbiotic relationship between industry, sea power and the national economy was evident during the industrial revolution. Britain's ability to harness this relationship was a key factor in her rise to power, which is recognised in Mahan's strategy. During World War II, this symbiotic relationship evolved as air power came of age since strategic bombing was a new threat to industry and the economy. This period contains many lessons for Air Force and Capability Acquisition and Sustainment Group (CASG), as competition escalated to conflict and preparedness changed to mobilisation. The Cold War was a period of great power competition that saw rapid technological advancements. The collapse of the Soviet Union illustrates the perils of an unbalanced relationship between the elements of national power. Throughout these eras there are lessons that are applicable to middle powers like Australia.

## 1. Introduction

Great power competition is not new and has been a feature throughout history. The Anglo-French rivalry spanned a period of 800 years and was followed by a period of competition with a rising German nation that culminated in World War II. Afterwards there was little respite, with the East vs West rivalry and the Cold War commencing in 1947. Therefore, the relatively peaceful 30 years that Western nations enjoyed after the Cold War could be viewed as an aberration in history. With Australia now involved in the United States (US)–China strategic competition and facing the prospect of war in the Pacific, there are lessons that we can learn from history.

The lessons from history can be framed at the national strategic level using the national power elements, which include economic power, military power and national morale. Economic power encompasses industrial and financial systems. Military power is defined by the size and quality of armed forces, with sub-categories including air power and sea power. National morale reflects the population's support for national goals. History shows the relationships between national power elements change as nations move across the peace-war spectrum. Careful management of these relationships can create powerful effects with the national power elements reinforcing each other. Unbalanced relationships can have dire consequences.

This paper argues that the elements of national power should have a symbiotic relationship; and lessons from history can be applied in today's context to ensure this relationship is balanced. First, the symbiotic relationship will be explored during the Anglo-French rivalry, where Mahan made the connection between sea power and economic power (Mahan, 1890/2011). Second, Mahan's strategy is evolved and applied in the World War II context where air power came of age, and there are lessons about preparing

for mobilisation. Finally, the Cold War period is explored where space power emerges and there are lessons for sustained periods of great power competition.

## 2. Mahan's strategy

The early modern period saw great power rivalries and the beginning of the symbiotic relationship between sea power and economic power in a globalised context. The Anglo-French rivalry began in the Middle Ages and persisted into the nineteenth century (Gibson, 1995). The character of this rivalry evolved during the sixteenth century, as developments in maritime technologies enabled colonisation and global trade. Mahan is well known for his strategy that links sea power with the national economy, and this maritime strategy was a key factor in England's rise to power. '[T]he great navy of England, in war after war, swept the seas, insured the growing wealth of the island kingdom through exhausting strifes, while drying up the external resources of French trade and inflicting consequent misery' (Mahan, 1890/2011, p. 61). In times of conflict the English navy protected their trade, while enabling the English to prey upon French trade ships and colonies. This resulted in economic growth and increasing national power within England, while the French economy declined during most of the conflicts in this period. These are early examples of sea power growing the economy and national power in a globalised context. The economy and industry growing sea power is the other half of the symbiotic relationship.

One of the few times the French Navy defeated the British demonstrates the importance of industry in the symbiotic relationship. The French made a concerted effort to rebuild their fleet after the Seven Years' War (1756–1763). Shipyards were provided with increased access to the raw materials required to build and maintain the fleet (Dull, 2007; Williamson, 2016). Maritime infra-

structure was modernised, ship designs were optimised, then standardised to moderate costs during production and maintenance. Improvements were also made to sailor training and living standards. An expansion in colonial trade and the fishing industry also provided a larger pool of experienced sailors that the Navy could draw upon in a crisis (Byington, 2011). These industrious efforts paid dividends when the French entered the American Revolutionary War, only 12 years after the Seven Years' War ended. The French Navy was able to match the British and in 1781 the French fleet was able to aggregate and blockade Chesapeake Bay. This blockade prevented resupply to General Charles Cornwallis at Yorktown, which was a decisive turning point in the war (Byington, 2011). This example demonstrates a concerted effort to uplift all the Fundamental Inputs to Capability (FIC), which improved preparedness and produced results in conflict. Civilian industry's contribution to naval infrastructure, ship building and generating an experienced maritime workforce enabled a strong navy. That navy then protected French colonies and trade while making a decisive contribution to the British losing the American colonies, which again demonstrates the symbiotic relationship. In today's context, Capability Managers need to ensure all elements of FIC are uplifted to drive increased preparedness.

### 3. Air power and the symbiotic relationship

During World War II, a symbiotic relationship developed between air power and economic power as strategic bombing was a new threat to industry. Air power can make significant contributions to maritime campaigns and affect the relationship between economic power and sea power as described by Mahan. For example, aircraft played a crucial role in the Battle of the Atlantic and the defeat of Germany's U-boats (Parker, 1989, pp. 95–97). However, the ability to strike at a nation's industrial and economic heartland is a unique air power capability. The Allies were eventually successful at defending their airspace and protecting their industrial centres that produced aircraft and other war material. The Allies strategic bombing campaigns also disrupted Axis industries. From 1942 to 1944, British aircraft production grew by 50%. This figure has been normalised by the structural weight of the airframe and labour hours required to construct the aircraft to account for all types of aircraft construction (Postan, 1952, pp. 524–525). Over the same timeframe, the production of individual German aircraft more than doubled but this was driven by increases in fighter production at the expense of large bombers and other aircraft types (Vajda & Dancey, 1998). Therefore, the Allied air campaign against Germany protected the British industrial heartland and enabled British industries to produce a variety of aircraft in increasing quantities. This included aircraft specialised for anti-submarine warfare and contributed to the classical Mahan symbiotic relationship in the maritime domain. Aircraft were also produced for offensive bombing campaigns against German industrial centres, which demonstrates the new character of the symbiotic relationship as air power came of age. On the German side, Allied successes forced the Germans to adopt a defen-

sive posture, which was also reflected in the symbiotic relationship between the Luftwaffe and industry.

While the Luftwaffe and German industry was on the defensive, Germany still managed to produce a substantial number of aircraft. The Germans dispersed their industry in response to the Allied bombing campaign and moved aircraft factories into repurposed tunnels. In some cases, purpose-built underground factories were also constructed. Aircraft designs were optimised for production and supply chains were streamlined by reducing the number of different parts used in aircraft designs (Uziel, 2006). British industry was also dispersed in response to German bombing during the Blitz (Postan, 1952, pp. 271–272). The Royal Australian Air Force (RAAF) and Capability Acquisition and Sustainment Group (CASG) of the Australian Department of Defence need to have plans to protect industry or mitigate the damage from strikes by dispersing industry and ensuring redundancy in industrial capabilities. This requires a shift away from co-locating most of our industry partners on RAAF Bases.

Repairing damaged aircraft is another way to boost industrial output. From 1940 to 1945, 79,000 of the 164,000 aircraft delivered to the Royal Air Force (RAF) from industry were repaired airframes. The percentage of repaired aircraft in the RAF fleet peaked at 55% in 1943. Prewar policy envisioned three RAF repair depots and three contracted repair depots under RAF control. By 1940, it was realised that this was inefficient since the fluctuations in demand for repairs resulted in wasted capacity within repair depots and a system was set up where repairs were spliced into organisations engaged in production. This had the added benefit that it was quicker and cheaper to repair damaged aircraft than building aircraft from scratch. With this change, control of civilian repairs transitioned from the RAF to the Ministry of Aircraft Production (Postan, 1952, pp. 537–545). In conflict, the RAAF is likely to move away from a routine aircraft servicing schedule designed to provide our industry partners with a consistent workload. Phased servicings that maximise aircraft availability are likely to become the norm in a prolonged conflict or crisis. This means our industry partners would experience fluctuations in workload associated with maintenance and repair. Enabling our industry partners to have the capability to manufacture parts is one way to smooth out these fluctuations and alleviate supply chain problems.

Shortages and supply bottlenecks were problems that needed to be overcome. For the RAF, insufficient spares were a problem until mid-1943, with 5–9% of all RAF aircraft unserviceable awaiting spares during this time. From late 1943 the issues with the supply of materials for parts manufacture were resolved. It took this long for the demands on parts to maintain the fleet, and aircraft production needs to be properly understood (Postan, 1952, pp. 543–545). The US mobilisation effort also experienced bottlenecks including shortages of raw materials, tooling, production capacity and transportation services. To effectively align production with national priorities, the allocations of three key materials, steel, aluminium and copper, were controlled. Less critical materials would then proportionately

flow to the companies allocated the key materials. This allocation system also enabled the US military to understand what would feasibly be received from industry, which informed long-range military planning (Maury, 2013). These types of shortages and bottlenecks are likely to affect the RAAF and industry during a future conflict or crisis. Within CASG, the platform-centric system program office (SPO) structure may have the resources to identify bottlenecks affecting individual aircraft types. But the lean higher echelons of CASG probably lack the resources to aggregate the information coming from the SPOs and efficiently resolve bottlenecks at the national level. In a crisis, the RAAF and CASG could consider merging the acquisition and sustainment SPOs to integrate the management of production and sustainment, while potentially enabling the higher echelons of CASG to expand. It is important that control of the supply chain remains within Government departments to maintain the trust of the public.

Within the US, the perception that companies profited enormously from World War I had left the public bitter and contributed to the US's isolationist stance. Before World War II, the US had implemented a tangled web of legislation and excess profit taxes to try to avoid war profiteering. Price ceilings and rationing were also required to prevent inflation during the war. Cost-plus contracts were common along with public-private partnerships to enable industry to scale, or convert to war production, while avoiding profiteering (Maury, 2013). Safeguarding against profiteering keeps the costs of military material down and avoids inflation in the wider economy, while also maintaining the trust of the public. Coordination across Government departments is required to implement these safeguards. CASG and other procurement agencies also need to have the skills, capacity and expedient contracting processes to be able to orchestrate supply chains in a crisis. This control is important to avoid the perception of profiteering or bias in rationing and may be required to maintain a stable national workforce.

Before the US entered the war the growing preparedness program had difficulties finding skilled workers. Despite high levels of unemployment from the Great Depression, these people were not in the right places with the right skills. This necessitated a massive training program in a hundred cities, where vocational schools would run two shifts, training the unemployed during the day and upskilling workers changing careers by night (Maury, 2013, pp. 82–84). In the year after Pearl Harbor, the US also struggled with workforce challenges and aimed to balance the civilian workforce in the agriculture and industrial sectors. These sectors were essential to supplying the military and the nation. The challenge with maximising productivity from a stable civilian workforce mainly came from enlistments in the military, people changing jobs chasing better wages, and companies raiding their rivals' workforces (Maury, 2013, pp. 333–334). Maximising the productivity of the available civilian workforce to meet Defence needs is a challenge we face today with constrained budgets and job-hopping from lower to higher paying companies. These challenges will be increased if preparedness turns towards

mobilisation and budgets are increased. CASG contracts should aim to manage wages or prevent uncontrolled movements of the workforce within the aviation sector.

#### 4. Great power competition during the Cold War

There were political, economic and military reasons for the collapse of the Soviet Union at the end of the Cold War. There was also an interaction between the economic and military reasons for the collapse. Soviet military spending is estimated to have ranged between 10% and 20% of GDP and was consistently agnostic of economic performance. Rising military spending at the end of the Cold War compounded Soviet economic issues and consumed resources that President Mikhail Gorbachev could have used to help with economic reform (Ray, 2025). This type of militaristic economic mismanagement is not an isolated occurrence; the devaluation of the Roman currency to grow the military and increase legionaries' pay caused severe inflation and contributed to the collapse of the Roman Empire (Van Sickle, 1930). Therefore the symbiotic relationship between military power and the economy must be balanced. Too much expenditure on military power is unsustainable, while too little expenditure leaves the nation vulnerable. Australian Defence spending was a sustainable 2.9%, on average, throughout the Cold War (Newett, 2025). Australia needs to lift Defence spending back to Cold War levels if we want to credibly prepare for a major conflict. This level of spending should also be sustainable during a prolonged period of strategic competition, but Defence needs to wisely spend this money.

The escalating costs of military hardware are a concern. 'Bombers cost two hundred times ... and ... fighters cost one hundred times more than they did in World War II' (Kennedy, 1987/2017, p. 442). Kennedy argues the divergence of the armaments industry from commercial, free-market manufacturing is a concern. The few gigantic armaments companies enjoy a special relationship with defence departments and are protected from the marketplace by generous Government contracts. The escalating costs in military hardware are a stark contrast with free-market consumer products where competition and mass production push prices down (Kennedy, 1987/2017, pp. 441–442). Caldwell and Howard also highlight three strategic challenges with contracting for platform availability in military sustainment. The first is managing risks and performance in large-scale contracts. If the risk associated with poor platform availability cannot be transferred to the contractor, then there should not be a risk premium payment for this metric in the contract. Second, outsourcing makes it challenging to retain the skills needed to manage existing and new long-term contracts. Third, the management of, and encouragement of innovation within, the supply network will be a challenge with the prime contractors in between Defence and the supply chain. This is why Defence needs to have a leadership and systems integration role within the platform enterprises (Caldwell & Howard, 2014). The RAAF and CASG need to foster and retain the skills necessary to lead our platform-centric enterprises and perform a systems integration role. This will enable Defence to

integrate innovative technologies onto our aircraft, while also being able to influence the supply chain and reward efficiencies. CASG should also work to counter the loss of buying power within the supply chain associated with several prime contractors managing parts or technologies common to multiple platforms.

The space race was a notable technological feature of the Cold War. Both the US and Soviet governments invested in space research and development. The Soviets took an early lead as the first to launch a satellite, while the Americans were the first to send a man to the moon (History Editors, 2026). Achievements in the space race provided propaganda benefits, since these technological advances were attributed to the superiority of each nation's ideology. The advances in rocketry were also associated with military missile prowess (Griffith, 1985). Successful rocket launches and other space achievements that are highly visible to the public boost morale, which is an aspect of national power. These successes can also be useful in diplomacy. Defence should continue to work with the Australian Space Agency and promote successes. Many space technologies are also dual use. Military technology that benefits the nation also forms part of the symbiotic relationship.

Government investment has influenced technological change throughout history. The risks associated with generating a return from research and development often leads to an under-investment in these activities from private firms. Within public funded research, the defence sector has had the largest budgets from governments around the world since World War II (Mowery, 2010). Numerous military technologies have also benefited the civilian sector. The space-based Global Positioning System and the jet engine are examples that revolutionised navigation and air transport respectively (Lange, 2025). While the development of military hardware is expensive, it can have long term benefits to the civilian sector and forms part of the symbiotic relationship. Defence should continue to invest

in research and development, while encouraging innovation within Australian industry.

## 5. Conclusion

Mahan identified that sea power could protect and grow a nation's economic strength in times of conflict. Conversely, economic strength and industry is required to build a military, therefore a symbiotic relationship is formed. The advent of air power saw the creation of a different symbiotic relationship, where strategic bombing can directly threaten industrial centres. If the symbiotic relationship is not balanced, it can also have dire consequences outside of war, as seen in the collapse of the Soviet Union. Therefore, it is vital that the elements of national power exist in a state of symbiosis. While this essay is not exhaustive, there are several lessons from history that are applicable today, which can help nurture this symbiotic relationship.

Australia needs to increase Defence spending back to Cold War levels and Capability Managers need to uplift all FIC elements to be prepared. To spend the Defence budget wisely, CASG and procurement agencies need to have the skills to orchestrate the supply chain. If competition escalates to conflict, effective Government control of the supply chain is essential to managing bottlenecks and avoid the perception of war profiteering or bias in rationing. The RAAF also needs to be able to protect industry in a conflict and CASG needs a mindset that acknowledges industry is a target. Redundancy in industrial capabilities and dispersal of industry provide defence in depth. In both competition and conflict, innovation is essential. Investment in research and development while encouraging innovation and efficiencies within the supply chain must continue. These all contribute to achieving a state of symbiosis between the national power elements.

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