Sharing Vulcan's Secrets:
Why States Disclose Details of Advanced Military Technology to Other States

By

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ABSTRACT

Why do technologically advanced states share cutting-edge military technology – the capability to produce weapons – with other states? Technology is a key component of national power, so sharing technology means making other states more powerful. I identify technology sharing as a unique form of interstate security assistance. Unlike alliances and arms sales, states cannot claw-back the capability technology provides if relations with a recipient worsen. As result, technology sharing's consequences last for as long as the transferred technology remains relevant.

I create a typology of technology sharing policies based on the ease and breadth of technology transfer they facilitate and explain choices amongst these policies with an original theory called Threats Over Time Theory (TOTT). TOTT predicts decisionmakers share technology when they face severe threats – to either the survival of their state or the organization that they lead. When such threats exist, decisionmakers adjust the liberalness of their desired technology sharing policy based two factors: the likelihood a future adversary may gain the technology because of the sharing – either through a leak or because recipient itself becomes an adversary – and the speed at which the shared technology is likely to become obsolete.

I test TOTT using cases during and between the World Wars – the most recent previous period of multipolar international competition. Using more than 40,000 pages of archival documents, I examine British and American decisions to share technology with each other, Japan, and the Soviet Union. In the process, I produce new or updated histories of these technology transfers.

The findings have implications for scholars' understanding of how decisionmakers make choices with costs and benefits that vary across time, tradeoff between relative and absolute gains, and prioritize state versus organizational interests. They also provide insight into how policymakers can consider the risks and benefits of technology transfer.

Thesis Supervisor: Barry R. Posen
Title: Ford International Professor of Political Science

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I first saw Vipin Narang at a talk for his then new book *Nuclear Strategy for the Modern Era* in Washington, DC. At the time, part of my job was to attend and report on such talks. Of the dozens I attended, Vipin was the only author who convinced me to buy his book on the spot. As one of the few junior faculty members in the Security Studies Program when I joined, he seemed an obvious addition to my committee – someone closer to the post-graduation job market I would face. As I finish, he is already a full professor. Though his comments in our meetings were often brief, they always struck to the heart of the issue.

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The mistakes that remain are mine alone.

Erik Sand
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Chapter 1
Technology Sharing

What constitutes state power in the twenty-first century? Questions of power lie at the heart of political science and international relations. Understandably, debates about the nature and constituents of national power are some of the oldest in the field.[1] Both states and scholars have long understood that technology contributes to state power, and its importance appears to be increasing. Biblical evidence suggests the Philistines protected their knowledge of ironworking to preserve their military superiority over the Israelites.[2] The Byzantines guarded the secret of Greek fire so jealously that they themselves forgot it, and the British went to enormous lengths to try to prevent others from learning the technological secrets of the Industrial Revolution.[3]

Classical realists like Hans Morgenthau and Klaus Knorr have explicitly mentioned technology as a component of state power.[4] Morgenthau included technology as a contributor to military preparedness, which he considered one of nine determinates of national power, noting, "the fate of nations and of civilizations has often been determined by a differential in the technology of warfare for which the inferior side was unable to compensate in other ways."[5]

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[1] A small sample of this debate includes: Hans Joachim Morgenthau, *Politics among Nations: The Struggle for Power and Peace*, 3d ed. (New York: Knopf, 1960); Robert A. Dahl, "The Concept of Power," *Behavioral Science* 2, no. 3 (1957): 201–15, https://doi.org/10.1002/bs.3830020303; Alexander Wendt, "Anarchy Is What States Make of It: The Social Construction of Power Politics," *International Organization* 46 (1992): 391–425, https://doi.org/10.1017/S0020818300027764; John J. Mearsheimer, *The Tragedy of Great Power Politics*, Updated edition., The Norton Series in World Politics (New York: W. W. Norton & Company, 2014); Thomas Risse, "'Let's Argue!': Communicative Action in World Politics," *International Organization*, no. 1 (2000): 1.

[2] Stephen D. Bryen, *Technology Security and National Power: Winners and Losers* (New Brunswick (U.S.A.): Transaction Publishers, 2016), 8.

[3] David I. Jeremy, "Damming the Flood: British Government Efforts to Check the Outflow of Technicians and Machinery, 1780-1843," *The Business History Review* 51, no. 1 (1977): 1–34, https://doi.org/10.2307/3112919.

[4] Klaus Knorr, *Power and Wealth; the Political Economy of International Power*, Political Economy of International Relations Series (New York: Basic Books, 1973), 50; Morgenthau, *Politics among Nations: The Struggle for Power and Peace*.

[5] Morgenthau, *Politics among Nations: The Struggle for Power and Peace*, 118.

Similarly, Robert Gilpin noted, "the diffusion of military and economic technology from more advanced societies to less advanced societies is a key element in the international redistribution of power."[6] Realists whose ideas are more prominent today, like Kenneth Waltz and John Mearsheimer, however, have elided the issue.[7]

Considering that technology has and will continue to play an increasingly important role in the material capabilities states can bring to bear against their adversaries, the reduced effort to theorize technology as part of power is surprising. For centuries, the amount of arable land a state controlled, and as a result the agricultural surplus it could use to support its army, was a dominating factor in a state's potential military power. The industrial revolution increased the importance of other raw materials, like iron, coal, and oil, as well as the industrial capacity needed to turn them into weapons of war. Even though the Correlates of War Project continues to include these kinds of industrial factors in their datasets as potential proxies for state power, modern scholars and world leaders know such factors provide incomplete information about state power.[8] During the Treaty of Paris negotiations in 1763, France faced a choice between keeping its vast Canadian territory or the two small Caribbean islands of Guadeloupe and Martinique. So lucrative was the slave driven sugar economy of the Caribbean islands that France chose to give up Canada. If a modern state found itself facing a similar choice, it would not be difficult to imagine it choosing to keep one technologically innovative city at the cost of similarly vast land tracts.

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[6] Robert Gilpin, *War and Change in World Politics* (Cambridge; New York: Cambridge University Press, 1981), 182.
[7]Kenneth Neal Waltz, *Theory of International Politics* (Long Grove, Ill.: Waveland Press, 2010), 131. Mearsheimer, *The Tragedy of Great Power Politics*.
[8] National Material Capabilities Dataset (v5.0), original version published in Singer, J. David, Stuart Bremer, and John Stuckey. (1972). "Capability Distribution, Uncertainty, and Major Power War, 1820-1965." in Bruce Russett (ed) Peace, War, and Numbers, Beverly Hills: Sage, 19-48.

Technology is an increasingly important component of state power for two reasons. First, technologically advanced states can achieve both higher overall levels of productivity and produce more powerful and precise weapons (or other means of influence) than can less technologically advanced states. Second, the resources that a state needs and can use to generate productivity or force are a function of that state's technology. Germany developed coal gasification technology to create substitutes for imported oil during the 1930s and 40s. Uranium had little practical value before the development of nuclear fission. Overall, as technology advances, the proportion of the value of an output that derives from technology as compared to raw materials continues to rise.[9]

Given these trends, the purpose of this dissertation is to further develop the theory surrounding technology as a component of national power. I seek to better understand how states control and manage their technology as a component of their national power. Several avenues for such a study exist, many of which have received study including:

(1) How do states develop and acquire technology?[10]

(2) How do they protect the technology they have from others?[11]

(3) How do they deploy the technology they have to gain their ends?[12]

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[9] Knorr, *Power and Wealth; the Political Economy of International Power*, 51–52.

[10] Andrea Gilli and Mauro Gilli, "Why China Has Not Caught Up Yet: Military-Technological Superiority and the Limits of Imitation, Reverse Engineering, and Cyber Espionage," *International Security* 43, no. 3 (Winter2018/2019 2018): 141–89, https://doi.org/10.1162/isec_a_00337; John VerWey, "Chinese Semiconductor Industrial Policy: Prospects for Future Success," *Journal of International Commerce & Economics* 2019 (2019): 1–36; Maaike Verbruggen, "The Role of Civilian Innovation in the Development of Lethal Autonomous Weapon Systems," *Global Policy* 10, no. 3 (2019): 338–42, https://doi.org/10.1111/1758-5899.12663.

[11] Robert M. Farley and Davida H. Isaacs, *Patents for Power: Intellectual Property Law and the Diffusion of Military Technology* (University of Chicago Press, 2020); James Johnson, "The End of Military-Techno Pax Americana? Washington's Strategic Responses to Chinese AI-Enabled Military Technology," *The Pacific Review* 34, no. 3 (May 4, 2021): 351–78, https://doi.org/10.1080/09512748.2019.1676299.

[12] Jonathan Shimshoni, "Technology, Military Advantage, and World War I: A Case for Military Entrepreneurship," *International Security* 15, no. 3 (1990): 187–215; Michael C. Horowitz, *The Diffusion of Military Power: Causes and Consequences for International Politics* (Princeton University Press, 2010).

I ask: When and why do states share the technology they have with other states? This question contains a puzzle and provides leverage on understanding how states manage their technology as a component of their national power. Theoretically and practically, why states pursue additional technology requires little explanation. If technology augments power, all else equal, states will seek to gain it. But regardless of why a potential recipient wants technology, sharing states must still decide to provide it. Attempting to protect technological secrets seems the default position, but states sometimes decide to share technology with other states. I focus on sharing states because their decisions to share or not share are often puzzling. The United States has refused to grant the United Kingdom, arguably its closest ally, access to some of the technology in the F-35 despite the United Kingdom being the only tier-1 partner in the program.[13] Conversely, in the 1980s, the United States transferred torpedo technology to China despite fully recognizing it might someday fight a naval war with China over Taiwan.[14] While scholars have studied alliances and arms transfers, excepting portions of the nuclear proliferation literature, no published work exists on why states choose to share advanced military technology.

Additionally, technology differs from other material components of national power in that it is non-rival. Only one state can control a particular field, mine, or factory. Even if states trade the productive outputs of such resources, only one state can possess a given bushel of grain, ton of iron, or tank at a time. One state must give up a unit of output for the other state to gain that unit of output. The same is not true for technology. If one state shares its technology with

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[13] George Allison, "How British Is the F-35?," UK Defence Journal, 2019, https://ukdefencejournal.org.uk/how-much-of-the-f-35-is-british-built/; "U.S. to Withhold F-35 Fighter Software Code," *Reuters*, November 25, 2009, https://www.reuters.com/article/us-lockheed-fighter-exclusive/u-s-to-withhold-f-35-fighter-software-code-idUSTRE5AO01F20091125.

[14] Hugo Meijer, *Trading with the Enemy: The Making of US Export Control Policy toward the People's Republic of China*, First edition. (Oxford; New York: Oxford University Press, 2016), http://nrs.harvard.edu/urn-3:hul.ebookbatch.GEN_batch:EDZ0001323451201606\23.

another state, the sharing state does not automatically give up the benefits of the technology – though it may increase the chances another state may be able to develop countermeasures to it. Thus, while a change in possession of a tank leads to both a relative and an absolute decrease in the providing state's power, sharing technology only leads immediately to a change in the sharing state's relative power. Few other opportunities exist to examine a transaction in which a state's relative power changes without a change in its absolute power.

The remainder of this chapter lays the theoretical groundwork for the theory and case studies that follow in the later chapters. First, I define technology and categorize technologies relative to the frontier of innovation. Second, I define and describe technology sharing as used throughout this analysis. Third, I compare technology sharing to other forms of security assistance – including arms sales and alliances – and identify the unique theoretical attributes of technology sharing. Fourth, I catalogue the various means of transferring technology. Fifth, I develop the dependent variable the dissertation seeks to explain – technology sharing policy – and the various values it can take.

Advanced Technology

I begin by defining and considering key terms. The first is technology. I define technology as the application of knowledge dealing with the mechanical arts and applied sciences for practical purposes and the product of such application.[15] Technological knowledge diffuses from technologically advanced states to less advanced states.[16] The pace at which technology diffuses varies as does the ability of states to make use of technological knowledge to

[15] Derived from the Oxford English Dictionary.
[16] Gilpin, *War and Change in World Politics*, 176.

which they gain access.[17] Technological diffusion occurs because of human action, and states can attempt to accelerate or slow the pace of technological diffusion through their actions and policies.[18]

It is a truism that different technological developments have different implications for international relations. Practitioners and scholars have argued that some technologies, or combinations of technologies – including but not limited to gunpowder, railroads and industrialization, aircraft, nuclear weapons, and precision guided weapons – have been so important as to have, in conjunction with accompanying organizational changes, spawned "revolutions in military affairs."[19] On the other hand, some technologies which received enormous investment and commanders declared pivotal in victorious campaigns – technologies which are clearly militarily important – have not received this honor.[20] The specific properties of some technologies – all of which had important battlefield effects – have different implications than others.

Scholars have generally taken two approaches to the challenges the specific properties of different technologies pose to theorizing about technological implications. The first approach is to develop a literature specific to a given technology or family of technologies. The quintessential example of this approach is the literature on the implications of nuclear weapons

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[17] Horowitz, *Diffusion of Military Power, The*.

[18] Miwao Matsumoto, *Technology Gatekeepers for War and Peace: The British Ship Revolution and Japanese Industrialization*, St Antony's Series (London: Palgrave Macmillan UK, 2006), http://nrs.harvard.edu/urn-3:hul.ebookbatch.SPRGR_batch:201610199780230504172; Gilli and Gilli, "Why China Has Not Caught Up Yet."

[19] Some examples include: Jeffrey R. Cooper, *Another View of the Revolution in Military Affairs* (Strategic Studies Institute, U.S. Army War College, 1994); Williamson Murray, "Thinking About Revolutions in Military Affairs," *Joint Forces Quarterly*, Summer 1997, https://apps.dtic.mil/sti/citations/ADA354177; Elinor C. Sloan, *Revolution in Military Affairs* (Montreal: McGill-Queen's Press, 2002).

[20] For example, William Douglas, who commanded the Royal Air Force's Fighter Command from November 1940 to November 1942 declared, "I think we can say that the Battle of Britain might never have been won…if it were not for the radar chain," but no one has declared radar a revolution in military affairs. "RADAR - The Battle Winner?," Royal Air Force Museum, accessed May 13, 2021, https://www.rafmuseum.org.uk/research/online-exhibitions/history-of-the-battle-of-britain/radar-the-battle-winner/.

and nuclear strategy. Studies of airpower, which focus on the characteristics of aviation technology, and of modern ground combat, which focus on the reaction to the overwhelming firepower of industrial-age gun (from small arms to artillery) technology, provide other examples.[21] This approach allows scholars to consider the implications of the package of characteristics specific to the technology under study, but makes generalization beyond that technology more difficult.

The alternative approach is to attempt to define a specific characteristic or implication a technology can have, theorize the implication of that characteristic, and identify the technologies which have it. The classic example of this approach is Offense-Defense Theory, which attempts – among other efforts – to theorize the implications of technologies which make offensive or defensive action easier relative to the other.[22] The challenge of this approach is that it engenders debate about how neatly different technologies can be assigned to the theoretical grouping required to derive implications from the theory to the real world.[23]

This study proposes an alternative approach. In an effort at generalizability, it eschews focusing on any specific technology nor does it focus on any specific theoretical characteristic. Rather, recognizing that technology is always changing – though technology advances at different rates at different times – it categorizes technologies by their effectiveness and relevance relative to technology at the frontier of innovation. This approach provides space to theorize across both time and a variety of technologies. This perspective does not mean that the specific

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[21] Robert Anthony Pape, *Bombing to Win: Air Power and Coercion in War*, Cornell Studies in Security Affairs (Ithaca: Cornell University Press, 1996); Stephen D. Biddle, *Military Power: Explaining Victory and Defeat in Modern Battle* (Princeton, N.J.: Princeton University Press, 2004).
[22] Robert Jervis, "Cooperation Under the Security Dilemma," *World Politics*, 1978; George Quester, *Offense and Defense in the International System* (New Brunswick, NJ: Transaction Publishers, 2003).
[23] Jack S. Levy, "The Offensive/Defensive Balance of Military Technology: A Theoretical and Historical Analysis," *International Studies Quarterly* 28, no. 2 (June 1, 1984): 219–38, https://doi.org/10.2307/2600696; Shimshoni, "Technology, Military Advantage, and World War I."

characteristics of technologies do not matter. Instead, it allows those characteristics to be considered as appropriate within the context of each case, while still contributing to broader theorizing.

Figure 1-1: Technological "Advancedness"

To that end, I define a spectrum of technological "advancedness" and focus the study on "advanced" technology. The advancedness of a technology is defined by the capability it provides relative to the frontier of military technology – NOT how old a technology is. This approach allows what is considered "advanced" technology to change over time as technological development continues. I define advanced technology relative to a spectrum of technology levels which runs from obsolete technology through prior-generation and cutting-edge technology to applied research and development (R&D) (See Figure 1-1). The top two levels of the spectrum – applied R&D and cutting-edge technology – are advanced technology, upon which this study focuses.

Each level of the spectrum is more precisely defined as follows. R&D is scientific and engineering work to develop and apply new technology to a particular problem. R&D itself must be divided between basic R&D and applied R&D. In general, basic R&D is not sufficiently developed to have specific military applications and thus is excluded from this spectrum. Therefore, the high end of the spectrum is applied R&D. The next major milestone is "cutting-edge" technology. This technology has been tested and fielded by the sharing state and represents the state of the art. The next step below is prior-generation technology. This technology is often still widely used in the sharing state's armed forces but is no longer cutting-edge. It still provides substantial capability but noticeably less than cutting edge technology.

Finally, below this level is obsolete technology. Obsolete technology has little combat value against cutting edge technology and is at a disadvantage against prior-generation technology.

Intermediate steps also exist along this spectrum. For example, states sometimes create reduced capability cutting edge technology. Such technology is often used to "export" versions of cutting-edge systems or sometimes as a cost saving measure. Sometimes these versions are not made available until some time has passed. Similarly, sometimes systems that are more than one generation behind cutting-edge technology exist that are not yet obsolete. Still, these steps along the spectrum provide key milestones for assessing how advanced a given technology is. The more advanced the technology that a sharing state shares the more potential benefit the recipient will gain but also the further into the future the value of that technology is likely to persist.

What do these distinctions means in practice? Prior-generation and obsolete technologies can still be of military value, even if very old – particularly against civilians, opponents with less developed technology, or even un-prepared or careless units armed with cutting edge technology. A well-trained unit armed with the Sharps rifle (lever-action, single-shot, effective range of 500 yards, rate of fire 8-10 rounds/minute) could still cause significant destruction with their ancient, obsolete weapons, but they would be at significant disadvantage against an equivalently trained and supplied unit armed with M16s (semi-automatic, 30-round magazine, effective range of 500 yards, rate of fire 45-60 rounds/minute). Similarly, 1940s-era internal combustion engine powered aircraft could severely harass modern ground units lacking air defenses but would lose in most engagements against modern fighter aircraft assuming both sides' operators had equivalent training.

Alternatively, some “old” technologies remain highly relevant. A gun-type uranium-fission device is now more than 75 years old, but even basic nuclear weapons convey tremendous advantage that technologically advanced states refuse to discount. Regardless, how “advanced” a technology is not about how old a technology may be, or even how much damage it can do, but how it fares against a well-trained adversary with cutting edge technology.

Technology Sharing

The second key term is technology sharing. An event qualifies as technology sharing if it meets three criteria: It is deliberate, government to government (or authorized and encouraged by both governments), and provided with the understanding that the recipient is gaining a capability to produce goods or weapons or otherwise implement the shared technology without further outside assistance.

First, the sharing must be deliberate. This requirement excludes incidents of accidental disclosure, espionage, or theft. It encompasses situations where the recipient may be gaining more knowledge than the provider anticipated or intended during an authorized mission. It also includes situations where the sharer provides some assistance but holds back some aspects of the technology (as this action would accelerate the diffusion of technology). While lax security or aggressive industrial espionage provide information about how states view technology in relation to their national power (or at least how conscious they are of its importance), they do not provide insight into why states *choose* to share their knowledge.

Second, the technology sharing must be between governments or authorized by governments with an understanding that other states will gain access to the technology. This theory seeks to understand state behavior and attitudes of states towards technology as a source of power. Thus, government actions and decisions matter. If private actors seek to share technology without any authorization or assistance from the state, the situation does not illuminate the state's attitudes. If, on the other hand, the private actor gains permission from the donor state to share the technology that state decision provides information and thus falls within the scope of the theory.

Third, the technology needs to be provided with the understanding that the recipient state will be gaining a capability to replicate the technology on its own. Technology sharing is an interesting phenomenon because it provides an avenue for a state to augment another state's absolute power, potentially permanently and, ostensibly, in a way that the donor state cannot control. Transferring technology also creates the possibility that the receiving state may be able to quicken its own research and development activities and keep up or even surpass the providing state in the future. This criterion helps differentiate technology transfer from arms sales, which augment the recipient state's power for a period of time (until the transferred item wears out). Arms sales often require continued maintenance or parts support from the providing country, which allows the provider to keep some leverage over the receiver. (There are situations where states have transferred technology and still attempted to create ways to maintain control over the use of the technology; those efforts do not exclude those cases from the study). This criterion implies that the receiving state must have sufficient technological and industrial development to assimilate the provided technology into its own technological portfolio.

An issue for this third criterion is the potential for reverse engineering. While direct instruction, provision of plans, licensing, or coproduction are usually better means for transferring technology because they facilitate tacit knowledge transfer, reverse engineering still provides a means through which arms sales can turn into technology transfer.[24] In these cases,

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[24] Udo Zander and Bruce Kogut, "Knowledge and the Speed of the Transfer and Imitation of Organizational Capabilities: An Empirical Test," *Organization Science* 6, no. 1 (February 1, 1995): 76–92.

one must look to the providing state's assessment of the risk of reverse engineering. If the providing state knew or should have known that reverse engineering was likely, then its decision to sell should be viewed as a decision to transfer technology. Similarly, if such knowledge led to a decision against selling, that decision should be viewed as a decision against transfer. Nonetheless, provider governments many not always foresee the possibility of reverse engineering even if it later occurs. Since this thesis is interested in explaining deliberate state decisions to transfer technology, it excludes cases where successful reverse engineering of an arms sale occurred as a surprise to the providing state.

An additional note on defining technology transfer: besides deliberate agreements to transfer technology and reverse engineering arms sales, states can also legitimately acquire technology though investment in or purchase of foreign firms. States often establish a special bureaucratic apparatus and set of rules, aside from export controls, to regulate foreign investment. For example, a small scandal recently arose in Britain when it appeared that the purchase of an electronics firm by a Chinese company, in violation of British foreign investment rules, facilitated the transfer of advanced electronics technology that enabled the Chinese to leap forward their production of railgun and electromagnetic aircraft catapult technology.[25] This thesis generally does not consider these cases, not because it assumes they operate under different rules, but simply to keep the project a manageable size. These cases may similarly provide a fruitful avenue for future research.

Technology Sharing Compared to other Forms of Security Assistance

Aside from technology sharing, states have several other ways to support the security of other states. Other forms of security assistance include intelligence assistance, training and

[25] Richard Kerbaj and Mark Hookham, "Has China Used British Technology to Build a Railgun?," *The Sunday Times*, March 4, 2018, sec. World, https://www.thetimes.co.uk/article/has-china-used-british-technology-to-build-a-railgun-n7blzkmdg.

tactics assistance (including combined exercises), alliances, and arms transfers. Previous scholars have identified the relationship between the two most studied options - alliances and arms transfers.[26] Each of these measures have different characteristics and are sometimes substitutes and sometimes complements.[27] In this section, I define several attributes that apply to the various forms of security assistance. I then use those attributes to compare the different types of security assistance to identify ways in which technology sharing differs as a means of developing a theoretical construct that applies specifically to technology sharing.

Forms of security assistance vary across five characteristics: risk to own capability, controllability, persistence, attributability, and visibility.[28]

Risk to own Capability describes potential losses to the supporting state's capability that could occur from providing security assistance. For example, when deciding to share intelligence information, the risk to own capability include risk that lax security in the receiving state may compromise the intelligence source. Such compromise would reduce the supporting state's own intelligence collection ability.

Controllability describes the ability of the supporting state to calibrate its assistance. Can the supporting state provide just a little bit of the described assistance or is it an all or nothing affair? How scalable is the assistance provided?

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[26] Keren Yarhi-Milo, Alexander Lanoszka, and Zack Cooper, "To Arm or to Ally? The Patron's Dilemma and the Strategic Logic of Arms Transfers and Alliances," *International Security* 41, no. 2 (October 1, 2016): 90–139, https://doi.org/10.1162/ISEC_a_00250.
[27] Yarhi-Milo, Lanoszka, and Cooper. Provides one argument for when alliances and arms sales are substitutes and complements.
[28] Different forms of security assistance can also vary by cost, but this trait often varies as much within a category as between categories. The variation occurs in part within one form of assistance the amount of assistance and its cost can very. For example, a small arms transfer will have a much lower cost than a battleship transfer. Variation in cost can also occur because states can negotiate how to split the costs of assistance. For example, an arms transfer could have high costs or produce revenue depending on whether the arms are sold or provided as aid. Similarly, an alliance could prove very costly if, in seeking to make it credible, one partner pays to station large numbers of its forces in another, but cheap if the host nation pays all the costs of the forces stationed on its soil.

Persistence is related to controllability and describes how long a recipient maintains the benefits of assistance after the providing state choses to cease supplying it. For example, while many alliances can be torn up overnight, weapons sold to a partner will function after the supporting state ceases deliveries. Even if the supported state requires spare parts deliveries to maintain its weapons, it is unlikely all the weapons in its possession will break the day after sales stop. The benefit the weapons provide will persist for some time.

Attributability is the ability of a third party to identify the source of support.

Visibility is related to attributability and is the ability of a third party to recognize the augmentation of the receiving state's power whether or not it can attribute the source of that support. The most deniable forms of support are neither attributable nor visible. Low-visibility support has little deterrent effect but may provide a significant capability advantage if it allows the recipient to surprise an adversary. Each category of security assistance provides different combinations of these five attributes.

Technology sharing's combination of attributes – particularly its combination of high risk to own capability and persistence – make it especially interesting for study. Technology sharing is usually attributable if supported states closely model the fruits of the shared technology on the sharer's systems and the technology is visible or can be forensically identified. Technology sharing is usually controllable – though the method states use to control the technology information they share affects this trait. Supporting states can decide precisely what aspects of their technology they choose to share, down to the component level. Technology sharing may not be visible if states seek to keep their support secret, which is often the case.

What differentiates technology sharing from other forms of assistance is its risk to own capability and persistence. The risk to own capability of technology sharing is high because sharing technological secrets could allow mutual adversaries to develop countermeasures to the technology sooner and, if the recipient has poor security, adversaries may be able to steal information directly from them. For example, in 2007, failures in Japanese security compromised classified technical data on the Aegis Combat System that the United States had shared with Japan.[29]

Technology sharing's high risk to own capability amplifies its most distinctive characteristic: its persistence. Once knowledge is shared, it cannot be taken away. Since technology sharing involves transferring the knowhow to produce weapons systems, little leverage exists through maintenance support or cutting off spare parts (though states can sometimes seek to create such leverage through withholding technology on key components). Thus, once technology is shared, the advantage provided to the recipient is essentially impossible to claw back. Sharing technology is therefore highly persistent.

Comparisons to other forms of security assistance highlight the uniqueness of the persistence of the advantage technology sharing provides. In alliances, the supporting state commits its own armed forces to come to the defense of the supported state. This commitment could occur through a formal or informal alliance mechanism or through a one-way security guarantee (for the present purpose, all are referred to as alliances). This commitment may or may not involve the supporting state stationing units in the supported state. Alliances are always attributable but may or may not be visible. They often lack controllability in that few gradations of alliance exist. If no pre-war foreign troop deployments occur, alliances are highly reversible. The ally simply does not join the war when asked as Italy did when it refused to honor the Triple

[29] Reportedly, one of the officers under investigation claimed he had come to possess the classified files on his computer when he had accidently copied them while copying pornography from another officer's computer. "Japanese Police Raid Naval Centre Over Aegis Data Leak," accessed September 27, 2019, http://www.spacewar.com/reports/Japanese_Police_Raid_Naval_Centre_Over_Aegis_Data_Leak_999.html.

Alliance in 1914. While troop deployments on the ally's territory make the political costs of renouncing alliances higher, it is still not impossible to do so. Thus, alliances have relatively low persistence.

When states provide intelligence assistance, they share information about the supported state's potential adversaries. This assistance could be broad, such as warning of a potential attack, or specific, including targeting data for an ongoing conflict or mapping information. Intelligence assistance is often low visibility and non-attributable. It is highly controllable. The supporting state chooses precisely what information it chooses to share. It is, however, potentially costly in that if the supported state is injudicious in its application of the intelligence it receives or has lax security, the supported state may compromise the supporting state's intelligence source, reducing its intelligence capability. Since much military information of tactical or operational use changes quickly, it has low persistence – depending on the information, this can be on the order of months.

Training and tactics exchanges include a large swath of activities including invitations to attend Service Schools, individual personnel exchanges, Subject Matter Expert exchanges, training missions, and combined exercises. These activities can improve the readiness of the supported state by improving personnel or unit level skills and by building interoperability. These exchanges are almost always attributable and usually visible (except for small-scale covert training missions). The risk to own capability is low (unless fighting begins during a joint exercise). Exercises and training are usually controllable since states negotiate over the types of operations exercises will involve. They usually have low persistence. While individual education experiences may shape specific participants for their careers, most training exchanges or combined exercises build short term readiness which dissipates in a matter of months. Training may have higher persistence when states deliberately use training to try to build an armed force for another state (e.g. pilot training, security force assistance). These programs, however, have patchy success records.[30]

Finally, arms transfers are most like technology transfers in that they also provide material support to the recipients. Nonetheless, there are still critical differences between arms transfers and technology sharing. Arms transfers involve providing finished or near-finished weapons systems for use by the supported state's armed forces. These transfers may occur as sales or as military aid and are often accompanied by training on the use of the systems. Transfers often include agreements for continuing maintenance support such as spare parts or maintenance teams. In some cases, supporting states provide on-site technicians and advisors.[31] Weapons transfers are usually visible, because the weapons need to be trained with and used to add value, and attributable, because rarely does more than one state produce identical weapons.[32] Exceptions occur when a technology has already proliferated to an extent that multiple sources could supply it or when a state deliberately attempts to obfuscate its support by supplying

[30] Rachel Tecott, "The Cult of the Persuasive: The U.S. Military's Aversion to Coercion in Security Assistance" (Doctoral Thesis, Cambridge, MA, Massachusetts Institute of Technology, 2021).
[31] For example, The U.S. Army touts that in 2017 it provided "$16 billion worth of U.S. Army weapon systems, *spare parts, training, maintenance and logistics services* to [its] foreign partners and allies [emphasis added]." "5 Things You Didn't Know about U.S. Army Foreign Military Sales - USAASC," accessed October 1, 2019, https://asc.army.mil/web/news-5-things-you-didnt-know-about-u-s-army-foreign-military-sales/.
More specifically, in May 2016, the U.S. Defense Security Cooperation Agency notified Congress of four potential Foreign Military Sales that consisted of solely "continued" or "follow-on support and services." "Major Arms Sales: May 2019 | The Official Home of the Defense Security Cooperation Agency," accessed October 1, 2019, https://dsca.mil/major-arms-sales/archives/201905. Some of these support services include activities, such as calibration, that must almost certainly take place in the receiving country. "Kingdom of Saudi Arabia – Aircraft Follow-on Support and Services | The Official Home of the Defense Security Cooperation Agency," accessed October 1, 2019, https://dsca.mil/major-arms-sales/kingdom-saudi-arabia-aircraft-follow-support-and-services-0. Russia provides similar support. Matthew Bodner, "Russian Arms Manufacturers Pull out of Venezuela over Late Payments," *The Telegraph*, June 3, 2019, https://www.telegraph.co.uk/news/2019/06/03/russian-arms-manufacturers-pull-venezuela-late-payments/. Ian Anthony and Stockholm International Peace Research Institute, eds., *Russia and the Arms Trade* (Solna, Sweden; Oxford; New York: SIPRI; Oxford University Press, 1998), 120.
[32] A notable exception is the AK-47. C. J. Chivers, *The Gun* (Riverside: Simon & Schuster, 2010), 215,342.

weapons produced by a different country.[33] Weapons transfers are controllable and scalable because the supporting state can make discriminate choices about the weapons systems that it chooses to supply and the level of capability of those systems.[34] Weapons transfers have slightly increased risk of unexpected cost as mutual adversaries could begin to learn about the capabilities of the weapons systems through the supported state's use – though the use of export versions of weapons can help reduce this risk. Unlike other forms of security assistance, weapons transfers have medium persistence. Unlike alliances, transferred weapons will continue to benefit the supported state even after a break with the supporting state. These benefits are likely to last years – longer than combined training or intelligence exchanges – usually until the equipment ceases to function or is rendered obsolete by innovation. Supporting states can reduce the persistence of the sales by seeking to choke off supplies of spare parts or maintenance support but receiving states can seek to mitigate this issue if relations appear to worsen by stockpiling parts or seeking them through third parties. The classic case of this behavior is support for F-14 fighters the United States sold to Iran shortly before the Iranian Revolution. Within two years of the Iranian revolution and the American arms embargo, the Iranians were seeking spare parts for the F-14s, but they have nonetheless kept a few of their original 79 aircraft flying to this day.[35]

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[33] For example, the U.S. initially chose to provide Afghan rebels fighting the Soviets in the 1980s with Soviet designed small arms. Robert Pear, "Arming Afghan Guerrillas: A Huge Effort Led by U.S.," *The New York Times*, April 18, 1988, sec. World, https://www.nytimes.com/1988/04/18/world/arming-afghan-guerrillas-a-huge-effort-led-by-us.html. This path has the obvious downside of producing no economic benefits for the supported state.
[34] Some states, for example, produce variants of their weapons specifically designed for export or sell tailored versions of their own weapons with reduced capability. Christian Catrina, *Arms Transfers and Dependence* (New York, NY: Taylor & Francis, 1988), 67. More recently, uncertainty exists as to whether the S-400 missiles Russia sold Turkey are the same version it operates. Benjamin Mueller and Thomas Gibbons-Neff, "What Is the S-400? The Russian Missile System in Turkey That Irks the Pentagon," *The New York Times*, July 12, 2019, sec. World, https://www.nytimes.com/2019/07/12/world/russia-turkey-missile-explain.html.

[35] "Iran's Air Force Flies American-Made F-14 Tomcats | The National Interest," accessed September 30, 2019, https://nationalinterest.org/blog/the-buzz/irans-air-force-flies-american-made-f-14-tomcats-24750. While from other Iranian aircraft also supports the view that suppliers can cut off spare parts to reduce leverage. At the time of the Iranian Revolution, Iran also possessed about 225 American built F-4 Phantoms, which were sold much more widely than the F-14. Parts availably has varied overtime, and both the United States and Israel themselves covertly

As Table 1-1 shows, technology sharing is the only form of security assistance with high persistence. It also is one of only two forms of security assistance with high risk to own capability. Regardless of the motivation for sharing technology, the persistence of the consequences of such action across time makes it much more likely that decisionmakers will have to weigh the long-term consequences of their decision against whatever short-term benefits they expect to gain. This difference adds an interesting complication to decisions in international relations.

Table 1-1: Comparison of the Traits of the Forms of Security Assistance					
	Attributability	Visibility	Controllability	Risk to own Capability	Persistence
Alliance	High	Variable	Low	Low	Low
Intel Sharing	Low	Low	High	High	Low
Training/Exercises	High	Medium	High	Low	Low
Arms Transfer	High	High	High	Medium	Medium
Technology Sharing	High	Low	Variable	High	High

Technology Sharing Methods

Once states have decided to share technology with another state, multiple methods exist for disclosing that technical information. Broadly, three options exist, none of which are mutually exclusive. First, the sharing state can provide documents with technical information to the receiving state. These documents could be research reports, technical manuals, maintenance instructions, or other similar information. Second, the sharing state could provide sample equipment. When sharing applied R&D, this equipment could include prototypes or laboratory or test equipment. When sharing technology in production, this equipment could include

sold Iran spares in the 1980s. Nonetheless, using scavenged or non-spec parts and cannibalization, Iran has managed to keep about 60% of its remaining ~123 F-4s serviceable, and statistic that has not changed since 2000. Even in the case of an aircraft that was widely distributed around the world and with intermittent parts support from the original supplier, Iran can only keep roughly a third of the aircraft it originally received flying. "Chapter Seven: Middle East and North Africa: The Military Balance: Vol 120, No 1," accessed May 6, 2021, https://www-tandfonline-com.libproxy.mit.edu/doi/abs/10.1080/04597222.2020.1707968.

manufacturing machines and tools or production samples. Importantly, in the case of shared equipment, an observer must assess the context to assess whether the purpose of the transfer is to share technology or is part of an arms sale. Prototypes and manufacturing equipment are strong indicators that the intention is technology sharing. When assessing production equipment transfers, a key criterion is the number of units transferred. Very small transfers – one or two units – indicate technology transfer may be the goal.

Finally, states may use people to transfer technology. In general, technology transferring via people can take one of three forms. First, states can send temporary technology missions. Two traits characterize temporary missions. They are usually short in duration, on the order of days to at most a few months. Additionally, the participants in the missions are not permanently reassigned; they are only temporarily away from their regular duties. Second, states can establish liaison missions. Unlike temporary missions, liaison missions are permanent, in that they have no pre-planned end date and that the mission is the primary duty of individuals assigned to it. A liaison mission member's role is to coordinate and facilitate ongoing technical engagement. While its members may have technical expertise, directly transferring or augmenting their own expertise is usually not their primary role. Third, states may exchange personnel. Like liaison missions, personnel exchanges are permanent in that the exchange role is the primary duty of the exchanged individual. Usually, exchanged personnel are directly embedded into the other state's organizations. Either the sharing or receiving state can send any of these types of missions/exchanges, the only difference being whether the goal of the personnel involved is to transfer or acquire technology (or both).

As previously discussed, the controllability of technology sharing is variable. Variations in the combinations of the methods a state uses to transfer technology determine the controllability. Two factors matter specifically. First, the extent to which the transfer is ongoing. Liaison missions and personnel exchanges are almost always ongoing – unless the sharing state deliberately cuts off exchange personnel from updated technical information. Temporary missions, by definition, are not ongoing. Provision of documents or sample equipment might or might not be ongoing depending on whether the policy is to continue to provide updated samples and documents. The other factor is the interactivity of the exchange. Interactivity reflects the ability of the recipient to prod for additional information by asking questions or analyzing parts. Obviously, any method of exchange involving people directly transferring information is the most interactive. The receiving state representatives can ask questions, build relationships, and potentially gain more information that they otherwise would have. Conversely, documents are the least interactive. Sample equipment lies in the middle because receiving states may sometimes be able to gain more information from analysis than from some documents. When interactivity and ongoingness are combined, as with exchanges of personnel, the likelihood the sharing state will pass tacit knowledge is highest.

Dependent Variable – Technology Sharing Policy

How can we best categorize, describe, and measure technology sharing? Up to this point, I have alluded to two possibilities: the specific advanced technologies involved and the controllability of the technology sharing. While I will describe some of the details of each in the cases, a broader measure is required. I define and use "Technology sharing policy" as that measure, which describes both the breadth of the technologies shared and a measure of controllability in a general enough fashion as to allow for macrolevel predictions.

Technology sharing policy describes a sharing state's policy toward one recipient state. It can also describe the desired policy of a ministry toward one recipient state. Technology sharing policies vary in how much risk they require a sharing state to accept that its technology may be turned against it in the future. Sharing advanced technology – rather than prior generation or obsolete technology – involves significant potential risk should the technology leak to an adversary or should the recipient itself become an adversary in the future. States share technology because decisionmakers believe the benefits of doing so outweigh these risks, but whenever a state shares technology, it is possible that somehow the recipient will gain more information or more advanced information than the sharer intended. States manage how much risk they accept by controlling not just whether they share advanced technology but also how tightly they monitor what technology is shared. But monitoring technology sharing more closely comes with tradeoffs. The more tightly a sharer controls information the more likely that bureaucratic impediments, rules, or procedures will prevent the recipient from gaining a piece of information the sharer would desire them to have. Tighter controls also risk alienating the recipient because they can breed a sense of mistrust or a (true) belief that the sharer is holding something back. Governments spend time debating what types of methods of control they are willing to employ in the context of technology sharing discussions – and are sometimes willing to consider a technology transfer using one method but not another, as occurred in negotiations between the United States and the United Kingdom in the years between the First and Second World Wars.

As a result, a state's decision to share advanced technology is not simply a binary yes-no choice, but rather an "if yes, then how?" decision. Technology sharing policy captures the "how" of technology sharing as well as the "yes-no." The more generous the technology sharing policy, the more likely the recipient will gain information the sharing state did not intend to provide.

Figure 1-2 shows the spectrum of technology sharing policies. At the high end, a state can allow open and unlimited transfer or exchange of cutting-edge military technology and applied research and development with only a few caveats; at the low end it shares nothing.

Figure 1-2: Technology Sharing Policy

The most controlled policy, of course, is to not share anything, but that is not a *sharing* policy. The most controlled policy that actually involves sharing information is to control and authorize individual transfers of technology, which I term "minimal." A minimal technology sharing policy involves one-off transfers of technology preceded by an individual discussion of the transfer at hand. The sharing state defines the assistance that will be provided; once that assistance is provided no more is expected. A single technical or training mission sent from one country to another is an example of a one-off transfer, so too is a one-time provision of documents. For example, in May 1938 the British and American navies conducted a one-time exchange of documents containing specifications and drawings of minesweeping equipment.[36] This interchange did not involve any expectation of further exchange on the subject, nor did any occur. Similarly, the Sempill Mission – the focus of Chapter 3 – was intended as a one-time delivery of naval aviation information from the British to the Japanese via a technical training mission of a definite period and supposedly without access to new British information developed after the mission had departed. Importantly, because of the difficulty of negotiating one-off transfers some states may have a policy of one-off transfer but rarely actually transfer technology

[36] David Zimmerman, *Top Secret Exchange: The Tizard Mission and the Scientific War* (Stroud, Gloucestershire; Montreal; Buffalo: Alan Sutton Pub; McGill-Queen's University Press, 1996), 31.

under it. This situation can be assessed if there are serious discussions about performing a one-off transfer of technology even if they never culminate in an actual transfer.

A "Specified" technology sharing policy is less controlled than a minimal policy. This policy permits the ongoing transfer of information without policy-level evaluation of each sharing event. This policy allows the transfer of new information that is developed but limits that transfer of information to specifically identified technologies, categories of technology, or technologies that meet specific criteria. This method of control uses "allowlists" that either specifically identify technologies eligible for transfer or list criteria that technologies must meet to be eligible for transfer. Obviously, if an allowlist uses eligibility criteria to describe the types of technology authorized for transfer, some evaluation of individual technology transfers against these criteria must occur. These evaluations are distinguished from one-off technology transfers by the existence of the pre-approved allowlist criteria and a routine organizational process to evaluate technologies against those pre-established criteria. Because the default is for technologies to be protected from transfer unless specifically included on the allowlist, this is still a relatively restrictive method of transfer, even as it reduces the costs of transactions transfers.

An "Open" technology sharing policy is the least controlled. In theory, a state with this policy might make all technologies a state possesses available for transfer. In practice, however, this almost never occurs. States almost always restrict some technologies from transfer though "blocklists." States using blocklists identify specific technologies that are prohibited from transfer or list criteria used to identify technologies prohibited from transfer. Like a specified technology sharing policy, an open technology sharing policy allows for ongoing transfers of technology. Unlike specified technology sharing policy, an open policy presumes that technology is authorized for transfer unless specifically prohibited.

Blocklists indicate less control than allowlists in two ways. First, as a heuristic, blocklists indicate less control because at a practical level they only make sense to use if the list of technologies prohibited from transfer is shorter than the those authorized for transfer. Second, blocklists provide less control than allowlists because *any* technology left off the blocklist is presumed authorized for transfer. This reduction of control occurs regardless of the types of technologies placed on the list. Blocklists minimize friction in technology sharing but create much more risk that technologies – especially developing technologies – that the sharing state would want to protect may be inadvertently disclosed to the receiving state.[37]

This chapter introduced the central question of this dissertation: When and Why do states choose to share advanced military technology with other states? It defined technology sharing as deliberate state to state transfer of information that improves the capability to produce weapons, and it limited its discussion to advanced technology defined relative to the frontier of innovation. It theorized that technology sharing is different than other forms of security assistance in that only technology sharing has both high persistence and high risk to own capability. It analyzed the methods states can use to transfer technology and defined a measurable dependent variable that is valid across time: technology sharing policy. Technology sharing policy captures both the breadth of sharing and some information on the methods of sharing to capture the risk to the sharer that technology sharing involves. The next chapter introduces Threats over Time Theory, which explains the factors affecting a ministry's preferred technology sharing policies.

[37] Or to any foreign intelligence service which has penetrated the receiving state.

Chapter 2
Threats over Time Theory

In this chapter, I outline a neo-classical realist theory for explaining state to state technology sharing I call Threats over Time Theory (TOTT). TOTT explains the preferred technology sharing policy – as introduced in the previous chapter – of the senior decisionmakers of government ministries. Of the ways states have to balance against threats by assisting other states, one factor makes technology sharing stand out. Technology sharing conveys potentially lasting benefits to the recipient that are impossible for the sharer to claw back should the recipient become hostile. TOTT builds on the analysis in the previous chapter that technology sharing is one of only two forms of security assistance that has a high risk to own capability and the only form that has a high persistence. This combination leads decisionmakers to weigh the long-term consequences of technology sharing more heavily than with other forms of security assistance. For a multiplicity of reasons, TOTT expects technology sharing to be rare and describes the factors lead it to occur. The most important factors governing decisionmakers' technology sharing choices are the threats they face, both in the present and those they believe they may face in the future. Technology, however, is not static. When technology is advancing rapidly, the persistence of the benefits of technology sharing to the recipient is reduced as technology becomes obsolete more quickly. Thus, when decisionmakers perceive a rapid pace of innovation, future threats restrain decisionmakers' preferred technology sharing policy less.

The remainder of this chapter explores these ideas in greater detail, generates testable predictions, and explains how I will evaluate those predictions. First, I examine the possible explanations for technology transfer that emerge from the existing literature. Second, I explain why technology sharing is uncommon. Third, I develop TOTT in detail describing its (1) scope conditions, (2) unit of analysis, (3) causal paths and (4) technology sharing policy predictions. I conclude the chapter with a discussion of my method and case selection criteria.

Existing Explanations

Despite technology's importance to national power, scholars have not deeply engaged the question of why states choose to share technology. Those who looked at the question have done so either as an adjunct to studies of arms sales or in the context of nuclear proliferation.[38] As a result, their explanations remain more closely tied to the peculiarities of the specific circumstances they investigate rather than technology sharing more generally. The broader international relations literature, however, suggests four types of arguments that could explain state technology sharing: technological, economic, organizational, and security-strategic. Each approach, as currently constituted, however, contains flaws.

First, technological development and complexity could explain technology sharing. Keith Krause suggests "exogenous" "technological innovation" led to "waves" of arms transfers throughout history.[39] Great powers seek the technology to produce cutting-edge arms to maintain their power positions. Technological diffusion occurs as states acquire capabilities concomitant with their technical capacity. Krause, however, largely assumes diffusion just happens once innovation "catalyzes" it.[40] His explanation ignores the role states and organizations play in

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[38] Kristin Trenholm, "How States Arm: Alliances and Economic Development as Determinants of Arms Sales and Military Technology Transfers" (ProQuest Dissertations Publishing, 2001), http://search.proquest.com/docview/275728749/; Matthew Kroenig, *Exporting the Bomb: Technology Transfer and the Spread of Nuclear Weapons*, Cornell Studies in Security Affairs (Ithaca: Cornell University Press, 2010), http://nrs.harvard.edu/urn-3:hul.ebookbatch.PMUSE_batch:20170722muse51852.
[39] Keith Krause, *Arms and the State: Patterns of Military Production and Trade*, Cambridge Studies in International Relations (Cambridge; New York: Cambridge University Press, 1992), 10.
[40] Krause, 23–25.

accelerating or slowing diffusion, and more recent scholarship emphasizes the essential role of agents in facilizing the diffusion of technology.[41]

An alternate technology focused argument suggests technological complexity leads to technology sharing. Stephen Brooks argues that modern technologies require so much investment that multi-national firms (frequently from different states) must engage in interfirm alliances that pool resources and amortize costs across multiple products to make complex technological developments possible, especially when it comes to weapons.[42] Like Krause's argument, however, Brooks cannot explain why some firms and states are allowed to participate in these schemes while others are excluded.

Second, economics might drive state technology transfer decisions. Scholars have frequently argued that economics drives arms sales.[43] Economic reasons for states to sell weapons include: to earn hard currency, to keep arms workers employed, or to gain economies of scale through greater production. Krause sees the pursuit of wealth by those who can innovate new weapons as one of the three factors that leads to technology diffusion.[44] He asserts that second-tier producing states will be more likely to sell weapons *and* designs – despite potential security pressures not to – because they lack sufficient domestic demand to sustain their defense industry without the added revenue that selling designs can provide.[45] Abdolali finds support for

[41] Matsumoto, *Technology Gatekeepers for War and Peace*; Gilli and Gilli, "Why China Has Not Caught Up Yet."
[42] Stephen G. Brooks, *Producing Security: Multinational Corporations, Globalization, and the Changing Calculus of Conflict*, Princeton Studies in International History and Politics (Princeton, N.J.: Princeton University Press, 2005).
[43] Nasrin Abdolali, "'The True Faith of an Armorer': A Comparative Study of the Causes of Arms Sales, 1950-1985" (ProQuest Dissertations Publishing, 1990), http://search.proquest.com/docview/303870527/; Andrew J. Pierre, *The Global Politics of Arms Sales* (Princeton University Press, 2014), http://portal.igpublish.com/iglibrary/search/PUPB0003307.html. Spencer L. Willardson, "Under the Influence of Arms: The Foreign Policy Causes and Consequences of Arms Transfers" (University of Iowa, 2013), http://ir.uiowa.edu/etd/2660.
[44] Krause, *Arms and the State*, 14.
[45] Krause, 32.

the argument that small and medium states are more likely to sell for economic reasons.[46] Willardson finds that the U.S. sells to advance its geo-political interests while Russia tends to sell for both geo-political and economic reasons.[47] Their results are consistent with arguments about selling weapons to maintain production at scale or to acquire hard currency. They suggest states sell weapons for economic reasons "when they must" to maintain their industry or balance of payments. An alternative economic argument suggests states use arms sales "strategically" to make their allies dependent upon on them.[48] These states sell arms at prices that undermine the development of indigenous weapons producers in the recipient state – or third state competitors. The debate over American drone exports provides a recent example. Supporters of drone exports argued, among other reasons, that prohibiting drone exports would allow China and other suppliers to both gain influence through selling drones to U.S. allies and to improve their own drone technology through increased production and revenue.[49] The economic logic that supports arms sales, however, does not easily translate to technology sharing. While technology sharing may generate licensing fees in the short term, it also creates the possibility that the receiving country may begin competing economically with the sharing country.[50] Similarly, while strategic sales of weapons may undermine the development of alternative producers, providing production information would have the opposite effect.

[46] Abdolali, "The True Faith of an Armorer."
[47] Willardson, "Under the Influence Of Arms."
[48] This argument arises from Strategic Trade Theory, which argues that firms sometimes support targeted trade protections to improve their competitiveness with foreign firms in third country markets, with the eventual goal of forcing the foreign firms to exit the third country market. This argument originally appeared in Helen V. Milner and David B. Yoffie, "Between Free Trade and Protectionism: Strategic Trade Policy and a Theory of Corporate Trade Demands," *International Organization* 43, no. 2 (1989): 239–72. For an version of this argument directly applied to using arms sales to create dependency, see Jong Choi, "U.S. Arms Transfers and Global Hegemony: An Analysis of Their Global Scale and the Regional Context of Japan and Korea" (ProQuest Dissertations Publishing, 1992), http://search.proquest.com/docview/304001242/.
[49] Erik Lin-Greenberg, "Why Washington's New Drone Export Policy Is Good For National Security," War on the Rocks, April 24, 2018, https://warontherocks.com/2018/04/why-washingtons-new-drone-export-policy-is-good-for-national-security/.
[50] Trenholm, "How States Arm."

Third, the behavior of sub-national organizations – such as departments or ministries of governments – could explain technology sharing. Though scholars have not previously sought to use organizational theory to explain technology sharing, they have used it to explain questions of military innovation and adaptation of new technologies.[51] Indeed, since understanding – and thus conveying – the details of cutting-edge technology requires technical expertise, technology sharing seems a subject on which the organizations possessing that expertise would be likely to make the policy that reflect their interests.

Organizational theory contains a wide and diverse set of ideas; a few key tenets are generally consistent. Organizations seek to accomplish a goal.[52] They seek to overcome or minimize any obstacle which interferes with the pursuit of their goal.[53] One of the most common and significant obstacles to achieving organizational goals is uncertainty.[54] Uncertainty originates both from the environment in which the organization operates and from the people it employs.[55] Organizations employ a variety of strategies to reduce uncertainty. At the broadest level, organizations seek to reduce uncertainty through increasing their autonomy and increasing their

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[51] Harvey M. Sapolsky, *The Polaris System Development Bureaucratic and Programmatic Success in Government* (Cambridge, Mass.: Harvard University Press, 1972), http://external.dandelon.com/download/attachments/dandelon/ids/DE0049FA453953B59516CC12575EF003995EE.pdf; Barry Posen, *The Sources of Military Doctrine: France, Britain, and Germany between the World Wars*, Cornell Studies in Security Affairs (Ithaca: Cornell University Press, 1984); Peter Feaver, *Armed Servants: Agency, Oversight, and Civil-Military Relations* (Cambridge, Mass: Harvard University Press, 2003); Deborah D. Avant, *Political Institutions and Military Change: Lessons from Peripheral Wars*, Cornell Studies in Security Affairs (Ithaca: Cornell University Press, 1994); Biddle, *Military Power*; Martin Van Creveld, *Technology and War: From 2000 B.C. to the Present* (New York; London: Free Press; Collier Macmillan, 1989).

[52] W. Richard Scott, *Organizations: Rational, Natural, and Open Systems* (Englewood Cliffs, N.J.: Prentice Hall, 1992); Barry Posen, "Foreword: Military Doctrine and the Management of Uncertainty," *Journal of Strategic Studies* 39, no. 2 (February 23, 2016): 159–73, https://doi.org/10.1080/01402390.2015.1115042; Stephen Peter Rosen, *Winning the next War: Innovation and the Modern Military*, Cornell Studies in Security Affairs (Ithaca: Cornell University Press, 1991).

[53] Posen, "Foreword"; James G. March, "Exploration and Exploitation in Organizational Learning," *Organization Science* 2, no. 1 (February 1, 1991): 71–87, https://doi.org/10.1287/orsc.2.1.71; William J. Abernathy, *The Productivity Dilemma: Roadblock to Innovation in the Automobile Industry* (Baltimore: Johns Hopkins University Press, 1978).

[54] James Q. Wilson, *Bureaucracy: What Government Agencies Do and Why They Do It* (New York: Basic Books, 1989), 221.

[55] Posen, *The Sources of Military Doctrine*.

share of resources.[56] Without autonomy organizations may need to take direction from outsiders. If those outsiders' priorities differ from those of the organization, the organization may face additional impediments to accomplishing its mission. Organizations seek autonomy to reduce the uncertainty and potential obstacles which could arise from such misalignments.

Organizations also seek to increase their resources – their size and wealth.[57] Surplus resources provide organizations depth to respond to unexpected challenges and reduce the impact of uncertainty. Organizations lacking sufficient resources may also need to rely on outsiders to complete core parts of their missions. The more an organization must rely on outsiders, the more leverage those outsiders will have over the organization should their priorities differ. Securing additional resources thus also enhances an organizations autonomy.

Pursuing autonomy and resources are particularly effective strategies for combating environmental sources of uncertainty, but organizations must also combat internal sources of uncertainty. A key way of doing so is with standard operating procedures, which establish regularized and repeatable methods of making assessments and accomplishing tasks.[58]

In general, organizational efforts to minimize uncertainty as well as the Standard Operating Procedures (SOPs) of military and naval organizations seem more likely to erect barriers to technology sharing than motivate it. First, specialized knowledge can be a source of resources and autonomy. The more tightly knowledge is controlled, the harder it is for outsiders of any sort to oversee the actions of the organization controlling that knowledge, which helps protect an organization's autonomy. Lack of oversight also makes it more difficult for outsiders to challenge calls for more resources.

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[56] Posen; Morton H. Halperin, Priscilla Clapp, and Arnold Kanter, *Bureaucratic Politics and Foreign Policy* (Washington, D.C.: Brookings Institution Press, 2006). Posen, *The Sources of Military Doctrine*.
[57] Wilson, *Bureaucracy*; Halperin, Clapp, and Kanter, *Bureaucratic Politics and Foreign Policy*.
[58] Posen, *The Sources of Military Doctrine*.

Change is a major source of uncertainty which organizations frequently resist,[59] and technology is a major source of change. Militaries and navies have frequently resisted the widespread introduction of new technologies to their own forces because new technologies often require change.[60] New technologies often require new systems which undermine existing SOPs and may require additional resources to develop. New technologies sometimes also lead to realignment of organizations and responsibilities – for example aviation leading to the creation of air forces – that can increase competition for resources and undermine autonomy. In the case of technology sharing, organizations usually have far more control over their own forces than the forces of another state. Sharing technology with another state risks the recipient could develop and adopt innovative ways to use the technology with which the sharing state military must then cope.[61] It is thus likely to be seen as potential source of increased uncertainty and opposed.[62] Military and naval SOPs likely increase this tendency. Armed forces value secrecy as a means of maintaining control and initiative (which help reduce uncertainty). They establish systems of classification to protect information, and bureaucratic processes to vet who may access protected information. Defaulting to secrecy is almost always a core feature of the SOPs. As Max Weber commented, “secrecy is the fighting posture of the bureaucracy.”[63] Such an approach creates a further barrier to technology sharing.

Circumstance do exist, however, when organizational impulses could make technology sharing more likely. Scholars of military innovation have dedicated substantial study to how the

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[59] Wilson, *Bureaucracy*, 221–334.
[60] For an example regarding machine guns see Chivers, *The Gun*, 25–39. For an example involving naval gunnery technology see Benjamin Armstrong, ed., *21st Century Sims: Innovation, Education, and Leadership for the Modern Era*, 21st Century Foundations (Annapolis, MD: U.S. Naval Institute Press, 2015).
[61] Horowitz, *Diffusion of Military Power, The*.
[62] The opposite is of course possible – militaries could share technology to minimize uncertainty through controlling the trajectory of the other military’s development and aligning its technology with the sharing state’s – is discussed further below.
[63] Posen, “Foreword,” 168.

differences between wartime and peacetime affect the implications of organizational theories. They have produced conflicting arguments as to whether war consistently eases the organizational obstacles to innovation.[64] The theoretical implications of war for technology sharing from an organizational perspective are similarly confused. On the one hand, war often re-enforces the military penchant for secrecy.[65] On the other hand, if fighting alongside allies, sharing technology could reduce uncertainty for militaries and navies if it allows for standardization or better information about a partner or adversary. Sharing technology with a partner armed force could facilitate standardization of both equipment and procedures with the partner. If the sharing state can impose its own technology and procedures through this process, it reduces uncertainty in situations where it must operate with its partner. "Interoperability," as it is called, has often been a reason given for sharing technology.[66] Such an explanation, however, also requires a theory to explain with which potential recipient states the sharing state's armed forces seek to become interoperable. Organization theory alone cannot provide this prediction. Thus, under wartime conditions, organization theory could predict that armed forces would be more likely to share technology with other states if both countries' armed forces are operating in close coordination.

Alternatively, the organizational impulses of non-military organizations could more readily motivate sharing. Scientific and academic organizations, whose goal is to develop and produce knowledge, often develop SOPs that support openness rather than secrecy because

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[64] Geoffrey Blainey, *The Causes of War* (Basingstoke: Macmillan, 1988); Rosen, *Winning the next War*; Williamson Murray, *Military Adaptation in War: With Fear of Change*. (New York: Cambridge University Press, 2011).
[65] For example, in 1940, Winston Churchill stated he would trust American information security more once their government was on a war footing. Winston Churchill, Minute to General Ismay, 18 July 1940, The National Archives of the UK (TNA): Premier 3/475/1, p. 33.
[66] Myron Hura et al., *Interoperability: A Continuing Challenge in Coalition Air Operations* (RAND Corporation, 2001), 13–15.

openness and exchange of information speeds innovation.[67] The shift of control over sharing military technology to such organizations could explain technology sharing, but such an argument would not explain variation in sharing policy between different recipient states.

Finally, states may share technology for security-strategic reasons. Such arguments are common explanations for arms sales and nuclear weapons technical assistance.[68] Structural realism explains the security-strategic motivation for technology sharing in its simplest form. Structural realists argue the distribution of power in the international system is the dominant force in shaping international politics.[69] Because states cannot appeal to a higher authority to resolve their disputes, states must see to their own security.[70] They have two means of doing so. They can seek to improve their own security through "self-help" – also sometimes described as "internal balancing." Either term implies the states seek to improve the quantity or quality of their own armed forces and other defenses. Developing new military technologies is a form of internal balancing. Alternatively, states can seek to band together with other states against threats – often termed "external balancing."[71] In this framework, technology sharing, like arms sales, is external balancing by assisting an ally to internally balance – that is, helping the ally get stronger. But while strict-structural realism benefits from parsimony, it lacks in explanatory

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[67] Theresa Velden, "Explaining Field Differences in Openness and Sharing in Scientific Communities," in *Proceedings of the 2013 Conference on Computer Supported Cooperative Work*, CSCW '13 (New York, NY, USA: Association for Computing Machinery, 2013), 445–58, https://doi.org/10.1145/2441776.2441827.
[68] For arguments on arms sales for geo-strategic reasons see: Pierre, *The Global Politics of Arms Sales*; Yarhi-Milo, Lanoszka, and Cooper, "To Arm or to Ally?"; Simeon Harvey, "No Room for Democracy in the Arms Bazaar: U.S. Arms Transfers in the Middle East and North Africa" (ProQuest Dissertations Publishing, 2015), http://search.proquest.com/docview/1723329566/. Willardson, "Under the Influence Of Arms." For arguments on nuclear assistance see: Kroenig, *Exporting the Bomb*; Julian Schofield, *Strategic Nuclear Sharing*, Global Issues Series (London: Palgrave Macmillan UK, 2014).
[69] Waltz, *Theory of International Politics*; Mearsheimer, *The Tragedy of Great Power Politics*.
[70] Waltz, *Theory of International Politics*, 168.
[71] Waltz, 105; Waltz, 168; Stephen M. Walt, *The Origins of Alliances*, Cornell Paperbacks (Ithaca: Cornell University Press, 1990).

power. It offers no explanation for variations in technology sharing policy towards allies nor can it explain sharing to states perceived as threats.

Other scholars have sought to combine structural realism's emphasis on security-strategic arguments with other explanatory factors. Most commonly, scholars have explained technology sharing as a combination of security and technical factors. Kristen Trenholm seeks primarily to explain patterns of arms transfers, which she claims occur when they produce "net military benefits to the seller." But she also argues that the transfers of military equipment escalate to technology transfer when the receiving state has the technical capability to absorb the technology involved in the sale.[72] Both arguments are wanting. The net military benefits to the seller construct is unfalsifiable. The added technology transfer does not fit the facts.

Matthew Kroenig explains nuclear weapons technology transfer through a combination of security motivations and the nature of nuclear technology – namely heightened utility for defense as compared to offense.[73] As a result, weak states without power-projection capabilities will generally seek to proliferate weapons to states that share a common power-projecting adversary. Non-power-projecting states susceptible to pressure from power-projecting states will be less likely to share nuclear technology. This theory explains much observed variation in nuclear technology sharing, but it provides little power in analyzing non-nuclear technology.

Alternatively, within the security-strategic framework, bargaining power could explain variations in technology sharing between different states that face a mutual threat. Scholars frequently suggest that countries sell arms as a means of increasing their influence.[74] Glenn

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[72] Trenholm, "How States Arm," 38.
[73] Kroenig, *Exporting the Bomb*.
[74] Abdolali, "The True Faith of an Armorer"; Choi, "U.S. Arms Transfers and Global Hegemony"; Bjorn Hagelin, "Into the Black Box? Technology Sharing in Major Arms Transfers and Beyond," *Defense & Security Analysis* 28, no. 2 (June 2012): 163–75, https://doi.org/10.1080/14751798.2012.678146; Pierre, *The Global Politics of Arms Sales*. Jennifer Spindel, "Beyond Military Power: They Symbolic Politics of Conventional Weapons

Snyder identifies five variables that affect behavior and bargaining within alliance relationships: dependence, strategic interests, explicitness of commitment, alignment of interests, and past behavior.[75] Assessing bargaining or instrumentality as an explanation for technology sharing is difficult. Sharing could occur as either an input to or an output of bargaining. Bargaining leverage could determine technology transfer. Yi-Ching Sun suggests a similar argument to explain variation in which state pays for transferred arms.[76] But technology sharing could also occur as a means to gain bargaining power. For example, states have offered arms sales to gain favor with other states.[77] Because security assistance could be either bargaining input or output and because of the contingency and condition-specific nature of bargaining, the bargaining explanation makes indeterminate predictions. Thus, while multiple schools of argument suggest various explanations for technology sharing, none provide satisfactory answers.

Barriers to Technology Sharing

In examining these families of arguments, we looked mostly at how they could explain when technology sharing occurs. But each of these families of arguments, plus some others, also provide reasons *not* to share technology. First, as discussed briefly, sharing technology can create long-term economic risks. States may fear that sharing technology may affect the competitiveness of domestic producers. Once in possession of sharing state technology,

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Transfers,"(presented to the MIT Political Science Department, Cambridge, MA 23 October 2017). Yi-Ching Sun, "United States Arms Transfers during the Cold War Years: An Explanation of the Transformation from Military Aid to Arms Sales" (ProQuest Dissertations Publishing, 1997), http://search.proquest.com/docview/304394029/.

[75] Glenn H. Snyder, "The Security Dilemma in Alliance Politics," *World Politics* 36, no. 4 (1984): 461–95, https://doi.org/10.2307/2010183.

[76] Sun, "United States Arms Transfers during the Cold War Years."

[77] Abdolali, "The True Faith of an Armorer"; Choi, "U.S. Arms Transfers and Global Hegemony"; Hagelin, "Into the Black Box? Technology Sharing in Major Arms Transfers and Beyond"; Pierre, *The Global Politics of Arms Sales*. Jennifer Spindel, "Beyond Military Power: They Symbolic Politics of Conventional Weapons Transfers,"(presented to the MIT Political Science Department, Cambridge, MA 23 October 2017). Sun, "United States Arms Transfers during the Cold War Years."

receiving state firms may enter markets that sharing state firms dominate and undercut them. Receiving state firms may use the provided technology as a springboard for further development. The years-long American effort to reduce Chinese intellectual property theft demonstrates the continuing salience of these concerns, even if it involves stolen rather than deliberately transferred technology. Economic rationales can provide a barrier to technology sharing.

Second, we have seen how military and naval organizations are likely to be averse to sharing technology most of the time due to their security focused SOPs. Organizations are similarly averse to the uncertainty created when foreign states have opportunity to develop new concepts from new technology. Finally, technological developments and the change they bring can threaten organizations' autonomy and resources. All these reasons explain why organizations resist technology sharing.

Third, because of the persistence of the benefits of sharing technology, technical disclosure – even to a friendly state – can create security risks. Sharing technology with another state now may risk providing an advantage to a future adversary. This situation can occur in two ways. First, the receiving state itself could "flip" on the sharing state – that is, a risk exists that the recipient state could become an adversary of the sharing state. A foundational assumption of realist theories of international politics is that states pursue their own interests. These interests can change quickly. In the Diplomatic Revolution of 1756, the European Powers reversed their longstanding pattern of alliances in less than six months. Similarly, Italy switched alliances in both the First and Second World Wars. While diplomats usually foresee shifting interests, uncertainty in alignment is a common feature of multi-polar systems. Because the advantages technology sharing can confer a lasting advantage to the recipient which the sharer cannot undo, the potential for such re-alignments acts as an obstacle to sharing under normal circumstances.

Second, even if a sharing state is confident in the future alignment of a recipient state, it may worry that sharing technology with one state may lead to its further diffusion to other hostile states. Such further transfer could occur intentionally if the recipient chooses to share the technology with others. It could also occur unintentionally due to lax security in the recipient state or, in time of war, because of a battlefield defeat that allows an enemy access to the technology. In either case, the more states in possession of technological information, the more likely it becomes that further states may gain access to its secrets.

Fourth, cognitive biases and information problems strengthen these arguments and further reduce the likelihood of technology sharing. Psychologists have found that humans tend to ascribe more value to items they already possess than to equivalent items they do not. Similarly, humans tend to feel more harm from the loss of something they already possess than they benefit they feel from the gain of an equivalent something they do not yet possess.[78] This "loss aversion" likely causes decisionmakers to upweight the potential security, economic, and organizational harms of technology sharing compared to potential benefits.

Fifth, asymmetric information problems create further barriers to technology sharing and exchange. Bernard Brodie divided information about military technology into two categories: demonstration – basic information about the existence of a functioning technology – and detailed – the information required to replicate it. He argued that military technological developments ranged from the simple to develop and easy to counter to those which "are not easily copied or countered even when their performance and general design characteristics are disclosed."[79]

[78] Robert Jervis, "Political Implications of Loss Aversion," *Political Psychology* 13, no. 2 (1992): 187–204, https://doi.org/10.2307/3791678.
[79] Bernard Brodie, "Military Demonstration and Disclosure of New Weapons [Conflict between the Legitimate Ends of Security in Military Technology and of Disclosure for the Sake of Demonstration Potential]," *World Politics* 5 (April 1, 1953): 290.

These latter technologies usually result from long-term research and development. The military advantage of "simple to develop and easy to counter" technologies derives mostly from surprise. Their demonstration can quickly undermine their military value. On the other hand, "not easily copied or countered" technologies retain the value when demonstrated. Nonetheless, Brodie argued that keeping "not easily copied or countered" technologies secret could limit adversaries' desire to produce similar technologies and prevent providing inadvertent development assistance.[80]

Thus, states must make careful considerations about what information to divulge about their technology. Because technology is almost impossible to claw back, states have incentives to guard it to protect their technological advantage. Receiving states, however, will not trade something of value for nothing. They will want enough knowledge about a potential partner's technology to assess the value of that technology to their own security.[81] Often, expert knowledge is required to adequately determine the value of a technological development. Thus, potential receiving states are likely to insist that their technical experts examine the sharing state's offered technology. At that point, however, the technology is practically divulged! Even if full information is not transferred the receiving state could already gain substantial knowledge from their expert review.

This situation creates incentives for states to refuse to allow review of secret technologies before sharing or exchange. Such refusals ensure asymmetric information between the two

[80] Brodie, 289–90.

[81] Alternatively, sometimes States make deals to access technology only to learn that the information they bargained for adds little they did not already know as happened when the United States made deals to pardon Japanese bio-weapons scientist in return for their research results. In this cases, asymmetric information lead to a deal of no value – though from a security standpoint, though, not a moral one, the United States had nothing to lose. Jeanne Guillemin, *Hidden Atrocities: Japanese Germ Warfare and American Obstruction of Justice at the Tokyo Trial*., 2017, https://lib.mit.edu/record/cat00916a/mit.002605459.

negotiating parties. In practice, this informational problem makes it easy for each side of a potential exchange to assume that its technology is more advanced than its potential partner's technology, which further impedes successful technology transfer negotiations.

These five separate theoretical perspectives provide ongoing, overlapping, and reinforcing objections to technology sharing. Even if one or two barriers to sharing do not exist in a particular case, the others may still be enough to block a decisionmaker from sharing technology. We should not only expect that technology sharing will be rare but also that determining which barrier to technology sharing is responsible for blocking a given technical transfer will be exceedingly difficult. As a result, the question in explaining technology sharing is twofold. First, what motivations to share technology under what circumstances are powerful enough to overcome these overlapping and reinforcing barriers to technical disclosure? Second, when such a powerful motivation exists, which, if any, of these barriers might still affect the scope of the desired technology sharing? Threats over Time Theory answers these questions.

Threats over Time Theory

In this section, I describe Threats over Time Theory (TOTT). *TOTT explains the preferred technology sharing policies of senior government decisionmakers*. It makes two central claims. First, the threats states (or on rare occasions organizations in a government) believe they face in the present and may face in the future are the most important factors in determining preferred technology sharing policy. Second, when deciding to share technology, environmental factors – namely the severity of threats and the pace of innovation – affect the relative importance of the present and future in determining the preferred technology sharing policy.

Scope Conditions

TOTT features scope conditions on three important dimensions. First, as discussed in the previous chapter, TOTT uses the term technology to mean the sharing of the *capability to produce* a weapons system and applies only to decisions to share advanced military technology. Second, also discussed in the previous chapter, TOTT only explains deliberate, state-to-state technology sharing. Third, I scope TOTT to technology sharing between great powers.

The great power condition captures two related criteria. First, in the modern world, states cannot be great powers without substantial productive and innovative capacity. Keith Krause categorizes the technical capabilities of weapons producers/suppliers into three tiers.

> -First-tier suppliers innovate at the technological frontier.
> -Second-tier suppliers produce (via the transfer of *capacities)* weapons at the technological frontier and adapt them to specific market needs.
> -Third-tier suppliers copy and reproduce existing technologies (via transfer of *design),* but do not capture the underlying process of innovation or adaptation.[82]

Krause further categorized non-weapons producing states as "strong customers" which "obtain...and use modern weapons" or "weak customers" who "either obtain modern weapons and cannot use them, or do not even obtain them."[83] The ability to innovate and produce weapons tailored to a state's specific needs allows a state to pursue an independent foreign policy, and to make independent decisions to wage and sustain war, in ways that third-tier producers and customers cannot. Third-tier producers' and customers' ability to wage conventional war against great power adversaries is limited by the willingness of higher tier suppliers to provide technology. Thus, the great power condition implies at least a state's technological capability in the First or Second Tier. The implication of this criterion is that recipient states will have the ability to make use of technology they receive and may be able to

[82] Krause, *Arms and the State*, 31.
[83] Krause, 32.

build upon it themselves. States that do not have the capability to assimilate and build upon the technology they receive are outside the scope of this theory. Second, great powers have the ability to pose a military threat to other great powers. This criterion matters because the ability of a potential recipient to pose a future threat to a potential sharer is a key variable in TOTT. Non-great power recipients, usually lack the ability potentially threaten the sharer.

Ministry Leaders as the Unit of Analysis

In general, TOTT takes the preferred technology sharing policy of the senior leadership of individual government ministries toward a specific potential recipient state as the unit of analysis.[84] It is a theory that predicts the preferred position of these senior ministry decisionmakers. This approach is both theoretically and empirically grounded and analytically and practically useful.

First, ministry leaders have the largest influence over technology sharing policy. Heads of government rarely make technology sharing policy decisions, instead, the senior leaders of the affected government ministries usually make these decisions. This delegation of responsibility occurs both deliberately and by circumstance. Like most policy issues, delegation of responsibility occurs deliberately. In part because of its potential long-term consequences, technology sharing rarely rises to the first rank of issues. Many issues compete for a head of government's time. These leaders must prioritize some issues on which to spend their time. Because the potential negative consequences of technology sharing often lie in the future, the issue is less likely to rise to the immediate concern of a head of government. More so than other decisions, technology sharing decisions also require substantial technical expertise just to

[84] Not all governments use to term "ministry" to describe their major functional units, but throughout this work I use the term generically to include all such functional units – departments, armed services, etc. – regardless of the official terminology used in any specific state.

understand the issues at hand. This expertise resides in the government's ministries, providing another reason for deliberate delegation.

Delegation also happens through circumstance. Because the expertise needed to fully understand technology sharing policy decisions usually only exists at the ministry level and because ministries are usually responsible for carrying out policies in their area of expertise, information asymmetries exist that can create a classic principal-agent problem. Put another way, with technology sharing, the devil is in the technical details. Even on the occasions when a head of government directs a ministry to engage in technology sharing, only the ministry has the expertise needed to decide what technical details to release or to withhold. As a result, if the ministry disagrees with the head of government's decision, it can often find ways to adjust the implementation of the technology sharing policy to achieve what it desires anyway. Such insubordination occurs more than once in the cases described in later chapters. Though one might expect that ministries would find it easier to erect barriers to technology sharing, most of the examples that follow feature the implementers of the technology sharing policy disclosing more information than the policy intended. To the extent that ministry leaders have sizable influence over actual technology sharing policy, this approach is practically useful.

Focusing on ministry leaders is also analytically useful. These leaders sit at the intersection of international and organizational pressures and must balance them as they seek to lead their ministries. Moreover, heads of government are not the only alternative source for technology sharing policy. Usually, more than one ministry has a stake in any given technical disclosure. These ministries often have different perspectives on technology sharing policy. Differences in ministries' perceptions of and exposure to international threats, organizational practices, bureaucratic interests, and information availability can all affect these variations.

These very differences provide an increased field of variation within individual cases even as performing within case and within government comparisons controls for many unobservable factors.

This approach does have one significant drawback: when ministries within the same government have different preferred technology sharing policies TOTT does not have a predictive mechanism to assess which policy the state will adopt. While one can easily say the eventually selected policy is a result of the "pulling and hauling" of bureaucratic politics, developing a system that constantly and successfully unpacks these power dynamics and negotiations is beyond the scope of this work.[85] Nonetheless, if all interested ministries agree on the same technology sharing policy such agreement should dramatically increase the likelihood the state adopts that policy.

Explaining Technology Sharing

As described in the previous chapter, TOTT takes technology sharing policy as its dependent variable. Four potential technology sharing policies exist. Under a technology sharing policy of "none," no technical disclosure occurs. One-off exchanges or disclosures characterize a "minimal" technology sharing policy. A "specified" technology sharing policy uses allowlists to control the technologies authorized for disclosure. An "open" technology sharing policy uses blocklists to control technical disclosures.

In the neo-classical realist tradition, TOTT prioritizes the role of threats in shaping technology sharing decisions, but it takes a more nuanced view of threat than does structural realism. TOTT recognizes that because of the persistence of the benefits technology sharing

[85] These differences in perspective are somewhat akin to Allison's Model III. Graham T. Allison, "Conceptual Models and the Cuban Missile Crisis," *The American Political Science Review* 63, no. 3 (1969): 689–718, https://doi.org/10.2307/1954423. Jonathan Bendor and Thomas H. Hammond, "Rethinking Allison's Models," *The American Political Science Review* 86, no. 2 (1992): 301–22, https://doi.org/10.2307/1964222.

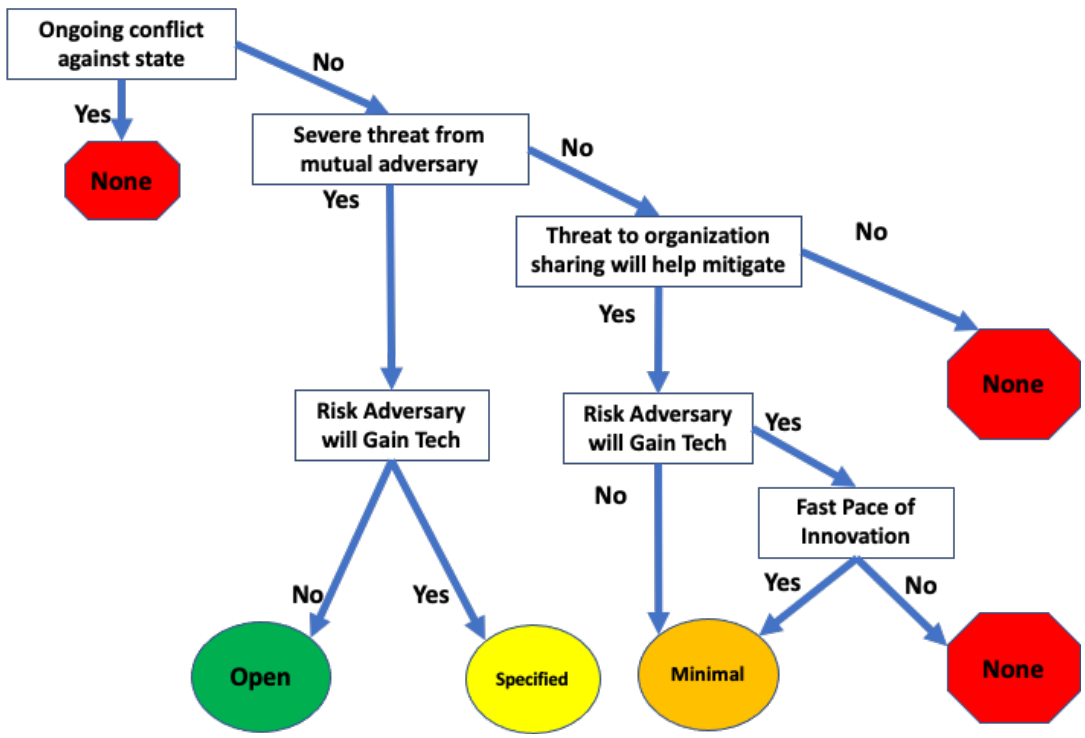
provides to the recipient state, decision makers must consider both present and potential future threats. The salience of future threats relative to present threats varies with environmental factors – namely the severity of the threat and the pace of innovation. Additionally, drawing from neo-classical realism – which allows for unit-level variables to affect state decisions within the constraints of international structure – TOTT recognizes that the frequent delegation of technology sharing policy decisions to leaders of sub-state organizations means that perceived threats to these organizations can also motivate technology sharing.

As such, five principles describe TOTT.

1. Threats drive decisionmakers' choices of technology sharing policy.
2. Decisionmakers consider both present and future threats in choosing their technology sharing policy.
3. Threats both to the state and to the decisionmaker's sub-state organization can drive technology sharing policy.
4. All else equal, when threats to the state and threats to the organization push in opposite directions, threats to the state win.
5. Under certain circumstances, leaders discount future threats in their technology sharing policy decisions more heavily:
    a. When threats are severe and immediate.
    b. When the pace of innovation is fast.

These principles introduce three variables which determine a decisionmaker's choice: current threats, risk an adversary will gain the technology, and the pace of innovation. Figure

Figure 2-1: Threats over Time Theory



2-1 displays graphically how these variables interact to shape technology sharing policy. Beginning in the upper-left hand corner of the tree, the first three nodes – ongoing conflict against state, severe threat from mutual adversary, and threat to organization that sharing will help mitigate – are different types of current threats. Most obviously, states will not share technology with other states with whom they are engaged in conflict – a severe and present threat – under any circumstance. The tree branches at the second node. The left side of the tree lays out the factors affecting a sharing decision in response to an international threat. It reflects only structural factors. The right side of the tree lays out the factors that drive sharing in response to a threat to a sub-state organization.

The left branch of the tree involves only factors of international politics. As standard neo-realist theory would predict, and the second node indicates, decisionmakers are highly likely to share technology with other leading technological powers if they face a severe threat from a mutual adversary – most commonly a major war. Such threats affect decisionmakers in two ways. First, the threat motivates balancing behavior.[86] In the case of technology sharing, the state externally balances by helping its partners internally balance. By sharing technology, the sharing state augments the recipient state's productive and military power, and ideally enables it to fight more effectively. Second, the severity and immediacy of the threat make the decisionmaker weigh the present benefits of the technology sharing more strongly compared to any future risks. This principle is the same as that in the adage that one must focus on avoiding the "alligator closest to the canoe" first. When under severe threat, decisionmakers focus on mobilizing as many resources as they can and taking as many steps as they believe are useful to ensure their state's continued survival past the present crisis. To that end, they are willing to share technology with partners with whom they would not normally share.

Even under severe threat, however, decisionmakers are not naive or ignorant of the future. They are not so blinded by current threats that they ignore "the other alligators." If a state shares a severe and immediate threat with a partner, a second factor affects the technology sharing policy: the risk that an adversary may gain technology because of the sharing. This variable encompasses two potential risks. First, the recipient may itself become an adversary of the sharing state in the future. The persistence of the benefits technology sharing provides and the inability for the sharing state to claw back those benefits lead decisionmakers to consider the potential long-term risks of technology sharing. The more likely the sharing state thinks the receiving state may become an adversary in the future, the more cautious it will be. While structural realism acknowledges that uncertainty about other states' future intentions can affect

[86] Walt, *The Origins of Alliances*.

states' decisions, scholars are divided over the effect. Waltz argues that uncertainty about future intention acts as such a strong benefit that states shy "away from running a future risk for the sake of a present benefit."[87] Alternatively, scholars that have explicitly examined tradeoffs in decisions between the present and the future, tend to find the opposite – present considerations weighted more heavily than the future.[88] The argument, in this case, is not that future concerns outweigh the immediate conflict nor that the future is disregarded, rather, technology is still shared, but future threats significantly restrain the liberality of the technology sharing policy.

The risk an adversary may gain technology because of sharing encompasses a second risk: the chance a known adversary may gain shared information from the intended recipient. Just as the persistence of the benefit technology sharing provides causes decisionmakers to consider the future alignment of the intended recipient, it also causes them to consider the chance sharing technology may cause the technology to reach a known adversary. Because states cannot claw back technological information, if technology leaks to an adversary, the original sharing state has few options. This situation differs from an adversary's capture of weapons sold to a partner. The sharing state may be able to destroy those weapons or limit the supply of consumables (ammunition, repair parts) that can reach the adversary. Indeed, general inability to claw back technical information is one reason states protect their own secrets. An adversary may gain technological information from an intended recipient in three ways. First, the adversary may take the technology by force – conquering labs or factories containing schematics and equipment or capturing scientists, engineers, and technicians. Second, the adversary may gain the information though espionage or open-source information collection if the recipient has

[87] Waltz, *Theory of International Politics*, 175.
[88] David M. Edelstein, *Over the Horizon: Time, Uncertainty, and the Rise of Great Powers* (Cornell University Press, 2017).

relatively weak security. Finally, the recipient may use the technology in ways that allow the adversary to gain information about it before the sharing state has been able to make full use of the technology.[89] If the sharing state judges any of these paths likely, it will restrain its technology sharing with a potential recipient state because of the risk an adversary could gain shared technology.

Thus, on the left branch of the tree, the technology sharing policy that occurs is a combination of the current threat facing the sharing state and the risk an adversary will gain technology because of sharing. If the sharing and recipient state share a severe mutual threat, TOTT predicts sharing will occur. The clear and present danger is sufficient to motivate some level of technology transfer, but the generosity of the technology transferred varies with the risk an adversary will gain from the transfer. If decisionmakers assess that there is little risk a present or future adversary will gain from the transfer, TOTT predicts they will select an Open technology sharing policy characterized by applied research and development collaboration and transfer of cutting-edge weapons technology both governed by a system of ongoing exchange that minimizes friction in the transfers. This technology policy is likely to be consistent across the various ministries or departments that make up the government. If, however, decisionmakers assess there is significant risk that sharing technology will lead a present or future adversary to gain, TOTT predicts they will select a Specified technology sharing policy – the sharing state will restrict either the level of technology transferred or insist upon a tighter method of control. Most commonly, TOTT expects a more open method of control combined with the transfer of

[89] States sometimes even restrict their own use of a weapons technology to prevent an enemy from discovering its secret. Britain and the United States refused to allow ground forces to use the proximity fuse until the Battle of the Bulge lest duds reveal its secret to the Germans. Similarly, during the First World War, the Germans instructed pilots of aircraft featuring Fokker synchronizing gear to avoid flying behind Allied lines, lest they be forced down allowing the Allies investigate the device. Frank T. Courtney, *The Eighth Sea* (Garden City, NY: Doubleday & Company, 1972), 82.

less advanced technology. Reflecting the immediacy of the mutual threat, this combination reduces friction in technology transfers while still reducing the risk that the shared technology may reach adversaries.

The right branch of the tree lays out how threats to sub-state organizations also lead to technology sharing. In line with neo-classical realist scholarship, TOTT holds that within the constraints of structural factors, unit level variables can also shape decision making on technology sharing, namely threats to sub-state organizations. Organizational explanations for foreign policy behavior have a long history.[90] Most frequently, scholars have placed organizational explanations in opposition to structuralist explanations.[91] TOTT sees these pressures acting simultaneously at the level of senior national security decisionmakers. Leaders of sub-state organizations responsible for national security face incentives both to protect the interests of their organization and of the state. Thus, just as severe threats to the state lead them to share technology when they otherwise would not, a threat to their organization can lead them to consider sharing technology with another state if they believe that doing so will help reduce the threat to their organization.

What is a severe threat to an organization? It is not a run-of-the-mill potentially disruptive change of the sort organization theory predicts organizations will resist. Rather, severe threats to organizations challenge either the continued existence of the organization as an independent unit within the government (in other words, a complete elimination of the

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[90] Organizational explanations for government behavior trace at least as far back as the writing of Max Weber. Kenneth Waltz's second image focus on state level explanations of foreign policy. Graham Allision's work popularized these ideas. T. Waters, Dagmar Waters, and Tony Waters, *Weber's Rationalism and Modern Society: New Translations on Politics, Bureaucracy, and Social Stratification* (New York: Palgrave Macmillan US, 2015); Kenneth Neal Waltz, *Man, the State, and War; a Theoretical Analysis*, Topical Studies in International Relations (New York: Columbia University Press, 1959); Graham T. Allison, *Essence of Decision: Explaining the Cuban Missile Crisis* (Boston: Little, Brown, 1971).
[91] Allison, *Essence of Decision*; Posen, *The Sources of Military Doctrine*.

organization's autonomy) or the ability of the organization to accomplish the fundamental goal it seeks to accomplish (as the organization sees it). Perhaps the best example of such a threat in twentieth century American history was the proposal to eliminate the U.S. Marine Corps as part of the post-Second World War defense reform – though the Navy thought unification in what would become the Department of Defense itself was not far behind.[92] Such threats to organizations are different because, like severe threats to states, they are existential. Existential threats make leaders willing to take risks they otherwise would not.

Critically, however, TOTT expects the risk that a present or future adversary could gain the technology because of the sharing still restrains organizational leaders in this circumstance. Leaders of armed services and their associated ministries or departments still maintain their responsibilities for national security. Indeed, when it comes to sharing technology when the risk exists it could reach a potential adversary, the national security risk is likely a risk to the organization as well. Armies are likely to control sharing military technology; Navies, naval technology; and Air Forces, aviation technology. A service that shares its technology when a risk exists that the technology could reach an adversary faces a real possibility that it may face off against the very technology it shared. As such, the risk of a future international threat still constrains the technology sharing motivated by an organizational threat.

The right branch of the tree accounts for an additional factor specific to sharing motivated by organizational threats: the pace of innovation. As previously discussed, because technology is usually advancing, TOTT defines a technology's level (R&D, cutting edge, etc.) relative to the capability of a technology at the frontier of innovation. As the pace of innovation increases in an area of technology, the faster the frontier of innovation moves away from any currently existing

[92] Alan Rems, "Semper Fidelis: Defending the Marine Corps," *Naval History*, June 1, 2017, https://www.usni.org/magazines/naval-history-magazine/2017/june/semper-fidelis-defending-marine-corps.

technology. As a result, when the pace of innovation is fast, the future value of a technology degrades more quickly than it would otherwise. TOTT holds that decisionmakers consider future threats in their technology sharing decisions because unlike other forms of security assistance, the benefits of technology sharing persist across time and cannot be clawed back. Innovation, however, eventually causes existing technology to move towards obsolescence, which reduces the value of previously shared technology. Thus, when the pace of innovation is fast, the risk that an adversary will gain because of sharing technology matters less because the shared technology will become obsolete sooner.

Evaluating the pace of innovation is inherently subjective, but that does not mean assessments of it are untethered from observable factors. Evaluating the pace of innovation is subjective because these assessments require estimating how innovation will develop in the future. If a cutting-edge technology is shared today, the rate of future innovation will determine how quickly the technology will become obsolete. Thus, the best way to assess what decisionmakers perceived the pace of innovation to be is to triangulate the pace of innovation in the immediate past – which is likely to shape perceptions – decisionmakers' statements about the pace of innovation and its implications, and additional policy actions those same decisionmakers took that the pace of innovation might also affect – for example increasing or decreasing information security. Still, accurate forecasting is notoriously difficult, so decisionmakers' subjective assessments may frequently be wrong.[93]

Summing up, on the right branch of the tree, the technology sharing policy a decisionmaker chooses is a product of three factors: a threat to his or her organization that sharing can help mitigate, the risk an adversary will obtain the technology because of the

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[93] Phillip Tetlock, *Expert Political Judgement*, *Expert Political Judgment* (Princeton, N.J: Princeton University Press, 2006), https://www.degruyter.com/document/doi/10.1515/9781400830312.1/html.

sharing, and the pace of innovation. When a threat exists to the organization which sharing can help mitigate and there is no risk an adversary will gain technology because of the sharing, a minimal technology sharing policy results – technology sharing transfers are likely to be considered individually, and the technology transferred is likely to be older or of less military significance. If a risk exists that an adversary may gain technology because of the sharing, TOTT also considers the pace of innovation. If the pace of innovation is fast, a minimal technology sharing policy is likely to result because the shared technology may soon become obsolete. In either case, the technology sharing policy is likely to be particular to the ministry. If the pace of innovation is not fast, then technology sharing is unlikely to result because the potential risk to the state outweighs the benefit to the organization.

Method

I test TOTT using in-depth cases studies of technology sharing during the period from the First World War to the Second World War. Case studies are particularly appropriate for evaluating TOTT. The foremost goal of this dissertation is to better understand how states view and manage their technological power. As such, TOTT focuses on the factors which affect decisionmakers' choices about sharing technology. Case studies are particularly suited for providing the depth of analysis and the understanding of causal mechanisms required for such an investigation.[94]

In these case studies, I use a combination of congruence testing, structured case comparison, and process tracing. As Steven Van Evera describes it, congruence testing involves

[94] John Gerring, "What Is a Case Study and What Is It Good For?," *The American Political Science Review* 98, no. 2 (2004): 341–54, https://doi.org/10.1017/S0003055404001182.

"looking for congruence or incongruence between values observed on the independent and dependent variable and values predicted by the test hypothesis."[95] Van Evera identifies two types of congruence testing. The first compares the values of the variables of interest in the case to their "typical" values. The second type makes multiple within-case comparisons of the values the variables take. I select cases that provide sufficient depth and breadth for the second type of congruence tests, eliminating the need to define "typical values." Evaluating within-case variation also provides the benefit of holding constant many potential confounding variables which could change between cases.

I augment both these methods with focused, structured case comparisons. Where congruence testing examines a case in comparison to typical values or within-case variation, structured case comparison compares multiple cases. Compared with congruence testing, structured case comparison holds a greater risk of confounding since no two cases are ever identical in all values taken by the explanatory variables as John Stuart Mill's "Method of Difference" requires. When used in conjunction with congruence testing, however, structured case comparison allows for the examination of variation not present within more limited cases and increases the likelihood of external validity by showing the theory's applicability across a greater variety of circumstances.

Focused, structured case comparison seeks to improve between-case validity compared to unstructured case comparison. Case comparisons are focused when they "deal only with certain aspects of the historical cases examined."[96] This requirement assists in highlighting the variables of specific interest to testing the theory at hand. Case comparison is structured when the

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[95] Stephen Van Evera, *Guide to Methods for Students of Political Science*., 1997, 932, https://lib.mit.edu/record/cat00916a/mit.000823363.
[96] Alexander L. George and Andrew Bennett, *Case Studies and Theory Development in the Social Sciences*. (Cambridge, Mass: MIT Press, 2005), 67, https://lib.mit.edu/record/cat00916a/mit.001329532.

investigator generates standard questions applicable to the subject under investigation that he or she applies in a standard fashion across the cases. Such a process allows for systematic comparisons across the cases. I lay out the questions I apply to each case later in this chapter.

Finally, I combine these methods with process tracing. Process tracing "explores the chain of events or the decision-making process by which initial case conditions are translated into case outcomes."[97] I use process tracing to supplement congruence and structured case comparison testing by identifying and tracking the causal mechanisms at play. This process helps evaluate the importance of third-factor variables in relation to TOTT's explanatory variables. Process tracing is particularly appropriate for evaluating TOTT because the theory seeks to explain the process by which leaders make decisions.

I apply these methods to test TOTT on cases of technology sharing, or lack of technology sharing, between great powers during the first half of the twentieth century – specifically sharing between the United States and Great Britain, Great Britain and Japan, and the United States and the Soviet Union. Van Evera identifies seven criteria that always apply for selecting cases for theory testing: (1) resemblance to current policy problem cases, (2) extreme values on variables, (3) large within-case variance in values of variables, (4) cases in which competing theories make divergent predictions about the case, (5) good case for replicating previous tests, (6) allows a new type of test, and (7) data richness.[98]

The selected combination of cases satisfies all seven of these criteria. (1) The world is returning to a multi-polar structure of international politics.[99] The first half of the twentieth

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[97] Van Evera, *Guide to Methods for Students of Political Science*., 1007.
[98] Van Evera, 1333.
[99] While most scholars and practitioners agree a U.S. dominated unipolar international order is ending, they continue to debate what polarity a new international order will exhibit. Some believe the order will exhibit U.S.-China bi-polarity. Yan Xuetong, "China, US in Race to Dominate Bipolar World," Australian Financial Review, June 17, 2019, https://www.afr.com/world/asia/china-us-in-race-to-dominate-bipolar-world-20190617-p51yib; Mercy A.

century was the most recent previous period of multi-polarity. (2) The selected cases include the transition from the First World War to peace and from peace into the Second World War as well as large shifts in the technology sharing policies of the powers. The period also includes changes in the pace of innovation and the threats sub-state organizations faced. (3) The multi-period study of Anglo-American technology sharing policy includes significant variation. The UK-Japan and U.S.-Soviet cases contain within-case variation as well. Within-case variation is further exploited by analyzing the varying positions of different internal bureaucratic entities within these governments when possible. (4) As further discussed below and in each chapter, each case provides a prediction that varies from at least one alternative explanation. (5) While previous tests of TOTT do not exist, the temporal proximity between these cases remain similar enough for them to act as partial replications of each other in most circumstances. (6) Since TOTT has not previously been tested, all the tests applied are new. (7) Choosing cases from the first part of the twentieth century ensures broad access to data on decisionmakers' considerations. Few, if any, classification barriers remain. Through deep archival research, I have uncovered significant new data for the cases at hand. Some of it, to my knowledge, has never previously been used in historical or political science scholarship.

Kuo, "The Return of Bipolarity in World Politics," accessed May 6, 2021, https://thediplomat.com/2019/02/the-return-of-biopolarity-in-world-politics/. Others expect a multipolar order: Joshua Ball, "The Early Stages of a Multipolar World Order," *Global Security Review* (blog), July 9, 2018, https://globalsecurityreview.com/the-early-stages-of-a-multipolar-world-order/. Still others expect a two-tiered order in which is multipolar with some characteristics of bipolarity. Richard Haass and Charles A. Kupchan, "The New Concert of Powers," April 29, 2021, https://www.foreignaffairs.com/articles/world/2021-03-23/new-concert-powers; Daniel W. Drezner, Ronald R. Krebs, and Randall Schweller, "The End of Grand Strategy," April 29, 2020, https://www.foreignaffairs.com/articles/world/2020-04-13/end-grand-strategy. Because the likelihood of a state "flipping" in a bi-polar order is much less than in a multi-polar order, technology sharing under bipolarity is likely to exhibit different patterns than technology sharing under a multi-polar order. Further research is needed to examine technology sharing under bipolarity.

Because this study relies heavily on archival research, I also follow the best practices for political science archival research Christopher Darnton suggests.[100] Documents are cited with as much precision as possible – down to the folder or bound unit in all cases and to the page or document number as well as document title where such notations exist. The dissertation contains an appendix of all archival material examined during my research, down to the folder or equivalent level. In general, my documentary research was exhaustive (rather than selective) of the files that appeared relevant to my topic. To the extent possible I have sought to review archival documents previously reviewed by historians writing on the subject, though COVID-19 pandemic restrictions have prevented me from returning to all archives to complete this task when I have found additional histories after initially visiting the archives. This condition applies principally to the Second World War cases. I have, however, sought out additional, previously unreviewed sources, including sources still classified at the time previous histories were written. When I did focus my document search, I did so in systematic ways. I used the Department of the Navy's contemporary file management system to identify filing codes which would contain material related to my questions. Finally, to the extent possible, I have sought and cited corroborating evidence for key arguments that validate the documents that provide key evidence that supports my theory.

Structuring the Case Studies

To evaluate this theory, I apply three sets of questions. In the first set, I ask three questions to determine if the case meets TOTT's scope conditions. The questions are:

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[100] Christopher Darnton, "Archives and Inference: Documentary Evidence in Case Study Research and the Debate over U.S. Entry into World War II.," *International Security*, 2017, https://doi.org/info:doi/10.1162/ISEC_a_00306.

1. Did the technology sharing under consideration involve transferring capability to produce advanced weapons or other items without further support from the sharing state?
2. Was the technology sharing that occurred or was under consideration government-to-government? Government facilitated and supported technology sharing meets this criterion.
3. Was the technology transfer that occurred or was under consideration deliberate (i.e. the technology transfer was known to be a likely outcome of the activity under consideration)?

Then, I ask questions to determine the technology sharing policy proposed or enacted.

1. Did the decision-making unit support any sharing of military related technology?
2. If yes, what technology sharing policy did the unit support?

Third, I ask the applicable questions to determine values of the TOTT explanatory variables from the following second set of questions.

1. What motivations, if any, did decisionmakers have to share technology?
2. How did sharing state decisionmakers assess future interest alignment with the potential recipient state?
3. Did the decisionmakers express concerns about the ability of the recipient state to protect technological secrets?
4. Did decisionmakers assess the pace of innovation in the technological area under consideration? If they did, did they assess the pace of innovation as unusually quick?

Questions apply based on the TOTT decision tree (See Figure 2-1). For example, I only ask question four if the decisionmakers are motivated by organizational threats and view the potential recipient as a future adversary.

Finally, I ask additional questions needed to evaluate the values of the explanatory variables associated with the most promising existing alternative explanations.

Single-period Structural Realism & Technological Capability

This alternative explanation predicts states should share technology solely to balance against current security threats. The more severe the threat, the more technology they should share. The sole factor which should restrain technology sharing should be a potential recipient state's inability to use that technology in opposition to the mutual adversary. These factors are assessed with questions related to TOTT.

Economic

The Economic alternative explanation makes two predictions. First, decisionmakers should share technology when they perceive their state or organization will gain economically such as through licensing fees. Second, decisionmakers will restrain their sharing when they are likely to lose economically – for example if they risk creating an economic competitor. Additional questions to those already asked:

1. Did the sharing arrangement involve monetary payments to the sharing state?

2. Did leaders cite economic benefits as an important rationale or haggle over them?

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

Organizational

This alternative explanation predicts that technology sharing should be a product of organizational motivations. In general, military organizations should oppose technology sharing because it can both increase the uncertainty they may face and violate their SOPs. The exception to this prediction is when an armed service must operate in close coordination with another state's armed force. In this case, the armed force may favor sharing to reduce uncertainty in the way the partner armed force operates. Alternatively, scientific organizations should support technology sharing since openness is usually the SOP of such organizations.

1. What was the role of military organizations in shaping the sharing decision?
2. If military organizations were involved in the decision, were their armed forces operating in close quarters with the potential recipient state's armed forces?
3. What was the role of scientific organizations in shaping the sharing decision?

In answering all these questions, I use a variety of types of evidence. Foremost, I employ public and private speech evidence about decisionmakers' perceptions and preferences. I give heavy weight to their stated reasons for taking a position, particularly if stated privately or if consistent statements were made in contexts unrelated to the decision. Indirect statements are included in the evaluation. For example, if documents show the increasing amount of time it takes to design new aircraft, I take this as an indication of a slowing pace of innovation. I also evaluate their actions. If decisionmakers state one position, but act in a different way, I give more weight to their action. When evaluating environmental conditions (threat, pace of technology), I also attempt to see the world as it was. For example, an obvious and severe reversal of battlefield fortune provides evidence of an increasing threat, even if leaders do not directly discuss it in their follow-on deliberations. When possible, I seek to corroborate answers to questions across multiple types of evidence.

The rest of the dissertation contains five additional chapters. The next chapter examines the British mission to share naval aviation technology with Japan after the First World War. The fourth chapter counterposes this mission to Japan with the U.S. and British attempt to share naval aviation technology in the same period. The fifth chapter traces selected aspects of U.S. and British technology sharing in the 1930s and through the Second World War. The sixth chapter evaluates U.S. and British technology sharing with the Soviet Union during the Second World War. The last chapter concludes.

Chapter 3
The Sempill Mission: Anglo-Japanese Naval Aviation Technology Transfer, 1920-1924

In March of 1921, a contingent of about 30 British naval aviators and supporting technicians, as well as more than a hundred aircraft, began to arrive in Japan as part of a "civilian" mission that would train the Japanese Navy in British naval aviation techniques, including many British technological accomplishments. Led by a former Royal Air Force pilot and aristocrat named William Forbes – also known by his title The Master of Sempill, the mission would last until September 1923 when the Great Kanto Earthquake truncated it six months early. In addition to operational training, the British provided details on cutting edge aircraft and weapons design. Most importantly, they helped the Japanese complete the design of the world's first purpose-built aircraft carrier the *Hosho*.

Why did the British provide this technology to the Japanese when they already perceived Japan to be a growing threat to British interests – especially when Britain faced no immediate security threat? TOTT predicts that threats to the existence of a government organization or its ability to perform its core mission can also motivate technology sharing. It also predicts that technology sharing may be more liberal when the pace of innovation is quick. In this case, I argue that the post-war crisis in British aviation provided a powerful motivation for the Air Ministry to seek to expand its influence – especially if the potential for aircraft sales existed. This crisis alone, however, was not enough for the technology transfer to occur. In addition, the leadership of the Air Ministry believed that the pace of aviation innovation after the First World War was so fast, that technology that was state of the art when the mission left England would be out of date by the time the mission concluded. Rapid innovation would mitigate whatever risks the transfer created. Indeed, as the perceived pace of innovation slowed, the Air Ministry soured on the mission.

The primary study of the Sempill Mission was published in 1982.[101] In it, John Ferris argues that the mission both occurred and shared far more information than the British ever expected it would because of misperceptions in the British government ministries involved in the decision. Many of the perceptions of British officials were inaccurate and bureaucratic skullduggery played an essential role in the eventual occurrence of the mission. Nonetheless, a detailed examination of the discussions surrounding the mission provides insight into how the British Government made technology sharing decisions. New sources, declassified since Ferris wrote, also deepen our understanding of the mission.

This chapter tests TOTT against several alternatives in the case of the Sempill Mission. It begins with a narrative overview of the mission from the initial Japanese request for assistance though the mission's execution and its aftermath and defines two periods between which values on key variables changed. In the second section, it demonstrates how the case meets the theory's scope conditions – necessary because the British government repeatedly asserted the mission was "unofficial." In the third section, it explores the arguments and perceptions of the various British government ministries involved in the mission. In the fourth section, it examines the potential alternative explanations. It concludes with an overall assessment of the case.

The Arc of the Sempill Mission

At the end of the First World War, Japan stood victorious and unscathed. It had joined the conflict against Germany under the terms of the Anglo-Japanese Alliance, originally concluded

[101] John Ferris, "A British 'Unofficial' Aviation Mission and Japanese Naval Developments, 1919–1929," *Journal of Strategic Studies* 5, no. 3 (September 1, 1982): 416–39, https://doi.org/10.1080/01402398208437125.

in 1902 and renewed in 1911. Aside from some minor action against isolated German colonies in China and the Pacific and a naval squadron dispatched to the Mediterranean, Japanese forces had seen little combat. The Japanese economy boomed as Japan both supplied materials to the Allies and made inroads into overseas markets the Allies had abandoned as they shifted their economies to war production.

Nonetheless, problems existed. The war's end brought economic contraction as war production orders dried up. A new naval arms race loomed. Many believed the pre-war Anglo-German naval arms race had helped spur the Great War. As American naval construction continued to grow, many believed a new Anglo-Japanese-American arms race would replace it – the Japanese were particularly concerned about the Americans. Moreover, the Japanese armed forces were behind the times. Having been spared most fighting in the conflict, the Japanese Army and Navy had had little opportunity to learn and adapt to modern warfare as European Armies had been forced to do during the war.[102]

The Japanese lagged in aviation. At the start of the war heavier-than-air flight had been possible for only 11 years. The conflict had taken military and naval aviation from an afterthought to a full-blown domain of warfare. The Japanese knew they were behind.[103] Knowing they needed to catch up, the Japanese resolved to follow a path like one they had taken in the 19th Century: they would enlist the aid of the most expert powers in the world to develop both the industrial infrastructure and actual force needed to become a viable air power.

In the 19th Century, Japan had arranged missions from France, Italy, and Germany to build its Army and modeled its Navy first on the Dutch and then on the British. From 1873 to 1879, a thirty-four-person Royal Navy mission led by then Lieutenant Commander Archibald

[102] C. R. Woodroffe, Report No. XC: Grand Manoeuvres, 16 Dec 1919, TNA: FO 371/3823, F.177951, p.458.
[103] Memo from the Japanese Naval Attaché in London, No Date, TNA: FO 371/5358, F2337/193/23, p. 10.

Douglas had trained the Imperial Japanese Navy on the British pattern.[104] With the First World War ending, the Japanese again looked to the victorious powers. In 1919, a French mission arrived in Japan to train the Imperial Army's aviation arm.[105] The intense inter-service rivalry between the Japanese Army and Navy meant this training would be inaccessible to the Japanese Navy but also provided an additional reason for the Japanese Navy to seek instruction in naval aviation.

Britain was the obvious choice first choice for the Japanese in seeking support for their nascent naval aviation program. Both remembered the help the British had provided the Japanese forty years earlier.[106] The two states were still treaty allies. More importantly, not only was the Royal Navy still regarded as the pre-eminent naval force in the world, but it was also viewed as the most advanced in naval aviation, a contemporary assessment that modern historians affirm.[107]

Just two weeks after the November 1918 armistice, the Japanese informally requested that the British Air Ministry send a naval aviation mission. The Air Ministry delayed a decision pending a formal request, and the subject was dropped, at least in London.[108] In the meantime the Japanese sent pilots to train in England.[109] They also continued to press British officials in Japan,

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[104] David C. Evans and Mark R. Peattie, *Kaigun: Strategy, Tactics, and Technology in the Imperial Japanese Navy, 1887-1941*. (Annapolis, Md.: Naval Institute Press, 2012), 12, https://lib.mit.edu/record/cat00916a/mit.003079237.
[105] Evans and Peattie, 301.
[106] W. Marriott, "Employment by Japanese Admiralty of Officers of Royal Air Force to teach Sea Flying," 19 Sep 1920, TNA: FO 371/5358, F2526/193/23, p. 33; Confidential Memorandum from the Japanese Naval Attaché in London, No Date, TNA: FO 371/5358.
[107] Ferris, "A British 'Unofficial' Aviation Mission and Japanese Naval Developments, 1919–1929," 419.Thomas Hone, Norman Friedman, and Mark David Mandeles, *American & British Aircraft Carrier Development, 1919-1941*. (Annapolis, Maryland: Naval Institute Press, 1999), 21, https://lib.mit.edu/record/cat00916a/mit.001984180.Evans and Peattie, *Kaigun*, 301.
[108] "Royal Air Force Instructors for Japan," Minutes of 63rd Meeting of the Air Council, 22 Nov 1918, TNA: AIR 6/16.
[109] For example, the British Air representative in Tokyo discussed meeting with Japanese pilots who had trained in England. Extract of letter from Capt. L. Wanless O'Gowan, R.A.F to Brig. General C.R. Woodroffe Military Attaché Tokyo, 28 Sep 20, TNA: FO 371/5358, F2683/193/23, p. 80

and in 1919 the British naval attaché encouraged the Japanese effort.[110] Buoyed by the confidence that the British were likely to accept their request, the Japanese Navy arranged a special budget line to fund a training mission.[111] In the fall of 1920, the Japanese approached the British again. First informally in Tokyo on September 25th or 26th, and then formally via the Japanese naval attaché in London on October 6th, the Japanese requested "a British mission, consisting of about twenty persons, to stay in Japan for the period of about one year, for training Japanese naval aviators."[112]

For the British this was not a straightforward request. Tensions between the British and the Japanese had increased during the war as the Japanese took British markets and tried to capitalize on the European war to advance their position in China.[113] Relations improved with the end of the war, but suspicion remained. Though Japan remained a British ally for the time being, the British government came to see the Japanese as their most likely foe. Japan was the focus of the Royal Navy's planning in the 1920s, and the other services considered the potential for conflict with Japan too.[114]

By the time the British Foreign Office received the formal request, the Japanese had already begun informal negotiations with the Air Ministry. On October 4th, two days before the

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[110] Confidential Letter No. 1133 from K. Nomura to Captain Marriott, 25 Aug 1920, TNA: FO 371/5358, F2516/193/23, p.37.
[111] Japanese Embassy Memo "Dispatch of British Service Air Officers to Japan for Instruction," 25 Nov 1920, TNA: FO 371/5358, F2941/193/23, p. 102.
[112] Extract of letter from Capt. L. Wanless O'Gowan, R.A.F to Brig. General C.R. Woodroffe Military Attaché Tokyo, 28 Sep 20, TNA: FO 371/5358, F2683/193/23, p. 80
; Letter from the Japanese Ambassador in London to Lord Curzon, 6 Oct 1920, TNA: FO 371/5358, F2334/193/23, p. 6.
[113] Ian Hill Nish, *Alliance in Decline: A Study in Anglo-Japanese Relations, 1908-23* (University of London: Athlone Press, 1972), 256, http://hdl.handle.net/2027/mdp.39015004072818; William Roger Louis, *British Strategy in the Far East, 1919-1939* (Oxford: Clarendon Press, 1971), 5, http://hdl.handle.net/2027/mdp.39015008643739.
[114] Andrew Field, *Royal Navy Strategy in the Far East 1919-1939: Planning for War Against Japan* (Routledge, 2004), 17; Louis, *British Strategy in the Far East, 1919-1939*, 52; Philip Towle, *From Ally to Enemy: Anglo-Japanese Military Relations 1900-45* (Folkestone: Global Oriental, 2006), 88, https://catalog.hathitrust.org/Record/005262827.

official Japanese request, the Air Ministry notified the Admiralty of the request and proposed an interdepartmental conference to discuss it. The Foreign Office began a coordination process. Each of the other affected departments – the Air Ministry, War Office, and Admiralty – began to consider this issue. The initial reactions were, in general, favorable. As would soon become clear, however, the Admiralty had grave concerns, and jumped at the chance to chair a meeting on the subject. The embassy in Tokyo sent its recommendations as well, but due to particularly slow communication, they would not be received until after the meeting, and thus did not affect the deliberations.[115]

The October 15th conference essentially decided the official British policy. The meeting included senior representatives of the Admiralty, Air Ministry, War Office, and Foreign Office. The Colonial Office was invited but did not attend. The ministries present were represented by some of their most senior career officials. Admiral David Beatty, a First World War hero and now the senior uniformed officer in the Royal Navy, chaired the meeting in his role as Chief of the Naval Staff. Three additional senior admirals attended. Air Marshal Hugh Trenchard, the Chief of the Air Staff and senior uniformed officer in the Royal Air Force, and Air Commodore J.M. Steel, the Director of Air Operations and Intelligence, represented the Air Ministry. General William Thwaties, the Director of Military Intelligence, represented the War Office. Victor Wellesley, the head of the Far Eastern Department, attended for the Foreign Office.[116] During the meeting, the Admiralty argued strongly against sending a mission, and in a reversal of its earlier position, the War Office joined these arguments. Initially, the Air Ministry and Foreign Office argued in favor of the mission, but the Foreign Office quickly ceded its position considering

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[115] W. Marriott, "Employment by Japanese Admiralty of Officers of Royal Air Force to teach Sea Flying," 19 Sep 1920, TNA: FO 371/5358, F2526/193/23, p. 33.
[116] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 40.

what it viewed as the power and priority of the Admiralty's arguments. The meeting resulted in the victory of the Admiralty's argument against sending a naval aviation mission. The Admiralty did compromise in permitting the possibility of a "civil aviation mission," which the Admiralty would later define as a mission that "would be merely engaged in teaching the Japanese how to fly."[117] The result of the conference was referred to Lord Londonderry, the Undersecretary of State for Air, who accepted its conclusions.[118]

Despite the meeting's decision, it took some time before the British communicated their refusal to the Japanese. While bureaucratic coordination over what excuse to give the Japanese caused delay, the Japanese pressed the issue.[119] Three weeks after the interdepartmental meeting and a month after making their request, the Japanese ambassador in London raised the issue in an interview with the Foreign Secretary Lord Curzon. The meeting was the first he had heard of the issue.[120] A few days later, the Foreign Office received a message from the Embassy in Tokyo that despite the British having not yet made an official response, the Japanese government had learned the Admiralty had blocked the mission. The Japanese appeared surprised and offended.[121] November 12th, the day before this message arrived in London, the Foreign Office finally informed the Japanese ambassador that a shortage of Royal Air Force personnel meant that while Britain would be unable to provide a naval aviation mission, it could offer a civil air mission instead.[122]

[117] For "civil aviation mission," see "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 44; For "would be…fly," see Admiralty Letter M.0730/22 to Air Ministry, 28 Jun 1922, TNA: FO 371/8050, F2209/1065/23, p. 17
[118] Letter from Charles Evans to Mr. O'Malley, 16 Oct 1920, TNA: FO 371/5358, F2460/193/23, p. 26.
[119] Minute by B.C. Newton, 9 Nov 1920, TNA: FO 371/5358, F2761/193/23, p. 84.
[120] Note by Lord Curzon, 8 Nov 1920, TNA: FO 371/5358, F2761/193/23, p. 84.
[121] Telegram No. 423 from Sir C. Eliot (Tokio), 13 Nov 1920, TNA: FO 371/5358, F2822/193/23, p. 97.
[122] Letter from Victor Wellesley to Baron Gonsuke Hayashi, 12 Nov 1920, TNA: FO 371/5358, F2761/193/23, p.90.

While the Japanese informally coordinated with the Air Ministry all along, at this point the formal and informal tracks diverged. Unbeknownst to the Foreign Office, on November 23rd, the Japanese appear to have informed the Air Ministry they would accept a civil aviation mission.[123] The Japanese Naval Attaché Captain Seizo Kobayashi soon began direct discussions with senior representatives of the civil aviation side of the Air Ministry. Despite this progress, the Japanese continued to push for a full mission. Just two days later, on November 25th, Matsuzo Nagai, the Councilor and second ranking diplomat at the Japanese Embassy in London, visited the Foreign Office. He pressed for a mission and offered that, if personnel were short, Japan would accept a smaller delegation.[124] He followed up the next day in person expressing surprise at the British refusal since British officials in Japan had offered a mission only the year before.[125] Wellesley spoke with him and explained that "no hope could be held out."[126] Four days later Nagai wrote again, this time appealing directly to Lord Curzon and requesting he intervene personally. Nagai argued that accepting the mission would be a signal of continued good intentions, writing the mission should "be viewed from a higher plane of the good relationship between the two nations."[127] This appeal led Curzon to bring the issue to the Admiralty again, though he did not advocate for a change in the decision. The Admiralty affirmed its stance. Still not wanting to give up, a week later the Japanese requested to send two naval officers to Britain for training in aerial navigation.[128] It would not be until December 22nd that the Japanese receive the final, official refusal from the Foreign Office.

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123 Letter from Frederick Guest to Lord Curzon, 4 Aug 1921, TNA: FO 371/6693, F2930/421/23, pp. 217-8.
124 Japanese Embassy Memo "Dispatch of British Service Air Officers to Japan for Instruction," 25 Nov 1920, TNA: FO 371/5358, F2941/193/23, p. 102.
125 Japanese Embassy Memo "Proposed British Air Mission to Japan to instruct Japanese Naval Air Service,"30 Nov 1920, TNA: FO 371/5358, F2992/193/23, p. 108 (Back).
126 Minute by Miles Lampson, 26 Nov 1920, TNA: FO 371/5358, F2941/193/23, p. 101.
127 Letter from Mr. Nagai to Lord Curzon, 30 Nov 1920, TNA: FO 371/5358, F2992/193/23, p. 111.
128 Letter from Mr. Nagai to Lord Curzon, 7 Dec 1920, TNA: FO 371/5367, F3134/3134/23, p. 196.

Because few files on the Sempill Mission appear to have survived outside the Foreign Office, what exactly happened next is unclear. Though the Japanese never formally responded to the Foreign Office's offer of a civil aviation mission, they continued to pursue such a mission with the Air Ministry. On February 3rd, 1921, the Air Ministry notified the Foreign Office and the Admiralty that the Master of Sempill would lead a British Civil Aviation Mission to Japan. Sempill would select the remainder of the instructors. Though the Air Ministry notified the other departments of the mission on February 3rd, it is likely Sempill had been selected earlier as the very next day he was already recruiting pilots he knew.[129]

Word of the mission spread quickly. The next week the Australian Government made a formal request to the Colonial Office in London that the mission include two Australians. Though the formal request stated the Australians simply wanted to gain "additional aeronautical experience," the Australians almost certainly hoped to gain information on the status of the Japanese naval air force.[130] This request appeared in the British Empire Report delivered to the Cabinet on February 16th. Though both the Australian government request and the discussion of it made clear the British Air Ministry was preparing to train the Japanese Navy, the news did not appear to spark significant discussion.[131] Almost simultaneously, reports of the coming mission began to appear in the United States. They would continue through the summer.[132] In every case,

[129] Frida H. Brackley, *Brackles: Memoirs of a Pioneer of Civil Aviation* (Chatham: W. & J. Mackay & Co. Ltd, 1952), 91.
[130] Telegram from the Governor-General of the Commonwealth of Australia to the Secretary of State for the Colonies, 11 Feb 1921, TNA: FO 371/6693, F 557/421/2, p. 165.
[131] British Empire Report No. 37, 16 Feb 1921, TNA: FO 371/6693, F704/421/23, p. 181 (Back) Of interest, Arthur Lee had become First Lord of the Admiralty on three days prior to this meeting. His predecessor Walter Long had left the cabinet.
[132] Minute by C.J.P W, 12 Feb 21, TNA: FO 371/6693, F704/421/23, p. 177; "A Brave Example: U.S. View on British Naval Policy," *The Times* (London), 17 Mar 1921, TNA: FO 371/6693, F791/421/23, p. 185; Letter from J.A. Webster to the Under Secretary of State, Foreign Office, Subj: Civil Aviation Mission to Japan, 9 Jun 1921, TNA: FO 371/6693, F2146/421/23, p. 204.

it appeared to these observers outside the United Kingdom that the British government was officially supporting the effort to train the Japanese.

The American attitude about the Sempill Mission varied. In the two years after the end of the First World War a simmering antagonism existed in some parts of Britain and the United States toward each other over their naval construction programs. At the time, many viewed the naval arms race between Britain and Germany that had preceded the War as a cause of the conflict. In 1916, the U.S. Congress had passed a naval bill that authorized construction of a Navy "second to none."[133] In Britain, navalists saw this construction program as a threat to the Royal Navy's traditional maritime supremacy, though the Admiralty knew it could not afford to compete in a building program with the United States. Additionally, many Americans saw no remaining target for the Anglo-Japanese Alliance but themselves – a situation the British recognized as they tried to navigate a course that maintained good relations with both Japan the United States. These tensions would both lead to and be resolved by the Five-Power treaty negotiated at the Washington Conference in late 1921 and early 1922, but in 1920 the conference was not yet even an idea. As a result, some American newspapers attempted to take the provision of the Sempill Mission as a sign of hostility on the part of Britain. The Daily News wrote that the mission was "a sure way to bring … about" "really serious trouble."[134] Other newspapers reported on the mission but described it as an unofficial mission of out of work aviators.[135]

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[133] Stephen Wentworth Roskill, *Naval Policy between the Wars* (London: Collins, 1968), 20, https://catalyst.library.jhu.edu/catalog/bib_247297.
[134] Daily news Clipping by P.W. Wilson – Headline: "America and World Peace: Feeling Over British Air Mission to Japan," TNA: FO 371/6693 F1195/421/23, p. 19.
[135] John Steel, "30 British Aces Agree to Train Japanese Flyers: Will Remain in Nippon Eighteen Months," Chicago Tribune Foreign News Service, 10 February 1921; ProQuest Historical Newspapers, https://search-proquest-com.libproxy.mit.edu/docview/174780485?accountid=12492, accessed 16 Oct 2020.

Historian Stephen Roskill believed the mission contributed to the Anglo-American naval antagonism.[136]

The British Government, however, did not see it that way. Foreign Office officials saw the concerns as produced by "French mischief" and the Hearst press.[137] Winston Churchill expressed similar opinions.[138] Some noted the American concern but believed that the British should not allow American concerns to dictate what policy Britain took toward its allies.[139] In the end, these concerns did not lead to a reconsideration of the mission, but rather a reaffirmation of its "unofficial" nature.[140] Though the need to balance relations between the Americans and the Japanese was an important consideration in British foreign policy in this period,[141] the issue appears to have little direct effect on the Sempill Mission.

The mission also attracted interest within the British Political establishment. In March and again in April, the Government received questions about the mission in Parliament.[142] On both occasions, MPs asked if the Royal Air Force was training the Japanese. The attention the mission gained overseas and in Parliament caused repeated additional inquiries within the government, usually from the Foreign Office to the Air Ministry, regarding the mission. In July, after the mission had arrived, Winston Churchill sent a letter inquiring about the mission to the Foreign Secretary.[143] Regardless of the questioner, the answer was always the same. As the government said in parliament: it was "understood that a certain number of civilians [had] been

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[136] Roskill, *Naval Policy between the Wars*, 245.
[137] Minute B.C. Newton, 18 Jul21, TNA: FO 371/6693, F2577/421/23 p. 205 (back).
[138] Private Letter from Winston Churchill to Lord Curzon, 13 July 21, TNA: FO 371/6693, F2577/421/23, p. 207.
[139] Minute B.C. Newton, 18 Jul21, TNA: FO 371/6693, F2577/421/23 p. 205 (back); Minute Lampson, "History of case in response to letter from Winston Churchill," 20 Jul 21, TNA: FO 371/6693, F2577/421/23, p. 206.
[140] Minute, Lampson, 20 Jul 21, TNA: FO 371/6693, F2577/421/23, p. 206.
[141] Louis, *British Strategy in the Far East, 1919-1939*, 52–53.
[142] Clipping from Hansard: "Japan (Air Service)," 23 Mar 1921, TNA: FO 371/6693, F1403/421/23, p. 198; "Question asked in the House of Commons," 14 Apr 1921, TNA: FO 371/6693, F1403/421/23, p. 193.
[143] Private Letter from Winston Churchill to Lord Curzon, 13 Jul 1921, TNA: FO 371/6693, F2577/421/23, p. 207

engaged by the Japanese as flying instructors."[144] Additionally, "as [the] undertaking [had] no official aspect so far as [Britain was] concerned, the question of the consent, approval or authorization of His Majesty's Government [did] not arise."[145]

As these political inquiries occurred in London, the mission moved forward with surprising speed. Sempill had only begun recruiting members of the mission in early February, but by early March, the first members had already departed for Japan.[146] They arrived in Japan on April 15, 1921.[147] This first contingent brought some equipment with it, and more would regularly arrive through late 1922. Sempill himself did not arrive until August 1921.[148] In all, the mission consisted of 29 British pilots, mechanics, and other experts, all former Royal Air Force (RAF) personnel to whom the Japanese gave ranks in their navy.[149] They brought with them a total 113 aircraft of 17 models, including five models which were then in British Fleet Air Arm use as well as various additional aviation equipment including ordnance and radios.[150]

On its arrival, the mission found a French instructor who had been teaching Japanese civilian pilots for more than a year as well as established maintenance shops.[151] The main airfield from which the mission would be based at Kasumigaura was in the final stages of construction. They assessed the Japanese progress as roughly equivalent to pre-war British aviation, but they also decided that most of the Japanese pilots needed complete retraining in basic flying before

[144] Clipping from Hansard: "Japan (Air Service)," 23 Mar 1921, TNA: FO 371/6693, F1403/421/23, p. 198.
[145] "Question asked in the House of Commons," 14 Apr 1921, TNA: FO 371/6693, F1403/421/23, p. 193.
[146] R. Vaughan-Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358, p. 40.
[147] Brackley, *Brackles*, 95.
[148] R. Vaughan-Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358, p. 40. There is some disagreement about exactly when Sempill arrived. Writing in 1924, Vaughan-Fowler, who had participated in the mission, recorded that all members of the mission had arrived by August 1921. Ferris, on the other hand, reports that Sempill arrived 26 weeks after the first members of the Mission, which would put his arrival in mid-October. Ferris, "A British 'Unofficial' Aviation Mission and Japanese Naval Developments, 1919–1929," 424.
[149] R. Vaughan-Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358, p. 37.
[150] Ferris, "A British 'Unofficial' Aviation Mission and Japanese Naval Developments, 1919–1929," 424.
[151] Brackley, *Brackles*, 99.

they could begin work on naval aviation.[152] The mission began with this approach, and while they often complained about the Japanese, their students learned quickly.[153]

The first evaluation of the mission's work came from the British naval attaché Captain J.P.R. Marriott in Tokyo and reached London in December 1921. It accurately described the work the mission was doing in support of Japanese Naval Aviation – the Embassy in Tokyo never did quite seem to understand that the mission was supposed to be for civil rather than naval or military aviation – but it also described the Japanese as poor pilots in a poorly run naval air arm, despite the mission's best efforts.[154] It further stated, contrary to press reports in the United States, that the American diplomatic mission in Japan claimed to have no concerns about the British mission despite their great interest in it and the recent arrival of the first U.S. Air Attaché in Tokyo.[155] Based on this reporting, the Foreign Office concluded the mission was a major coup.[156] The British would gain prestige (and perhaps weapons sales) in Japan; the Americans did not appear to care, and the Japanese were so incompetent they could not learn anything that would make them a threat.

The Admiralty did not agree. Though it did not react to the correspondence it received that detailed the nature of the work, after Captain Marriott returned from his posting in Japan, it became extremely concerned.[157] On May 19th, the Admiralty complained to the Foreign Office

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[152] R. Vaughan-Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358, p. 48-49; J.P.R Marriott, "Report No. 1 of 1922: Annual Report on the Imperial Japanese Navy," 25 May 1922, TNA: FO 371/8051, F2109/2109/23, p. 78

[153] Both Vaughan-Fowler and Brackley provided evaluations of what they thought the Japanese could become. R. Vaughan-Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358, pp. 57, 59, 62. Brackley, *Brackles*, 197–98.

[154] J.P.R. Marriott, "Report No. 8 of 1921, Subject: Civilian Air Mission in Japan, 3 Nov 1921, TNA: FO 371/6693, F4649/421/23, p. 224.

[155] J.P.R. Marriott, "Report No. 8 of 1921, Subject: Civilian Air Mission in Japan, 3 Nov 1921, TNA: FO 371/6693, F4649/421/23, pp. 224-5.

[156] Minute by C.B Newton, 20 Dec 1921, TNA: FO 371/6693, F4649/421/23, p. 222; Minute by Victor Wellesley, 20 Dec 1921, TNA: FO 371/6693, F4649/421/23, p. 222.

[157] Ferris, "A British 'Unofficial' Aviation Mission and Japanese Naval Developments, 1919–1929," 427.

stating, "it appears that the Civil Air Mission is employed in the type of work that the Admiralty specially objected to."[158] The Admiralty requested the Foreign Office withdraw its support for the mission and take measures "to prevent the further disclosure by similar means of British ideas and technical details in Naval aviation."[159]

The Foreign Office, which had always refused to take any responsibility for the mission, was incensed. They argued they had no responsibility for the mission and suggested the Admiralty consult with the Air Ministry before any further action occurred.[160] Surprisingly, this suggestion worked. After consulting the Air Ministry, the Admiralty declined to pursue the matter further. In October, they dropped their demand the mission end and even declined to send a message to the mission that it ought to be careful about what information it shared with the Japanese.[161]

Interestingly, as the Admiralty appeared to shift its position on the mission, so did the Air Ministry – in the opposite direction. At the same time as the Admiralty protested, Sempill's deputy, Herbert Brackley was back in England for his wedding. While there he sought to gain updated information for the mission. Writing to Sempill during his return passage to Japan in mid-November, Brackley decried the lack of official support. The Air Ministry had given specific instructions that the mission was not to receive "technical or other information of a confidential character."[162] Though Brackley also noted that despite this prohibition, he still found

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[158] Admiralty Letter M.6041 from O. Murray to the Under Secretary of State, Foreign Office, 19 May 1922, TNA: FO 371/8050, F1793/1065/23, p. 9 (Back).
[159] Admiralty Letter M.6041 from O. Murray to the Under Secretary of State, Foreign Office, 19 May 1922, TNA: FO 371/8050, F1793/1065/23, p. 9 (Back).
[160] Letter from B.C. Newton to the Secretary of the Admiralty, 7 Jun 1922, TNA: FO 371/8050, F1793/1065/23, p. 14
[161] Admiralty Letter M.01519 From Charles Walker to the Under Secretary of State, Foreign Office, 17 Nov 1922, TNA: FO 371/8050, F3821/1065/23, p. 27.
[162] Brackley, *Brackles*, 169.

some senior officials, including the Director-General of Supply and Research, who were willing to assist.[163]

Though the mission had originally been scheduled to end in the fall of 1922, the Japanese extended portions of it. Sempill, who appeared to most observers to have alienated the Japanese, left as scheduled.[164] Brackley took over the mission with a contract to stay until February 1924, though the mission would come to a sudden end with the Great Kanto Earthquake in September 1923. While the mission had initially fallen behind schedule because of the remedial flying instruction it felt the Japanese required, by the time Brackley left the Japanese had more than caught up. Japanese naval aviators were conducting long range seaplane flights and take-offs and landings from their new aircraft carrier *Hosho*.[165] The mission assisted with this work as well as with comparative trials of new aircraft for the Japanese and with experimental work to assist with technical development.[166]

Substantively, how much did the mission assist the development of Japanese Naval Aviation? Richard Samuels wrote that the mission provided Japan "a quantum leap in aviation training and technology."[167] Ferris suggested the mission allowed the Japanese to cover five years of development in two and that British technology transfer after 1919 was responsible for Japan being a naval power in the 1940s.[168] A third of the 2,000 Japanese Navy aircraft constructed in Japan in the 10 years from 1921 to 1931 were either designs licensed or copied

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[163] Brackley, 169.
[164] Brackley, 168.
[165] Brackley, 138. Brackley, 179.
[166] Brackley, *Brackles*, 185. Brackley, 188.
[167] Richard Samuels, *"Rich Nation Strong Army": National Security and the Technological Transformation of Japan* (Ithaca and London: Cornell University Press, n.d.), 110.
[168] Ferris, "A British 'Unofficial' Aviation Mission and Japanese Naval Developments, 1919–1929," 435; John Ferris, "Armaments and Allies: The Anglo-Japanese Strategic Relationship, 1911-1921," in *The Anglo-Japanese Alliance, 1902-1922* (London; New York: RoutledgeCurzon, 2004), 262.

from the British.[169] How much aid the mission provided in aircraft design is difficult to assess. Two additional truly private missions of British designers and engineers came Japan around the same time, one at the Mitsubishi Company and the other at the Yokosuka Dockyard Aviation Works.[170] They would design aircraft the Japanese would use for a decade and establish the Japanese aviation industry. The Sempill Mission helped test these aircraft.

Given this additional aid in aircraft design, the mission's most important technological contributions were likely to be weapons, radios, maintenance, aircraft carriers, and carrier aviation. The mission provided information that helped the Japanese finalize the design of the first Japanese aircraft carrier, including its all-important flight deck.[171] It almost certainly provided the details of the arresting gear for both the ship and the aircraft.[172] The mission brought up-to-date radios and bombs. The mission provided the Japanese their first torpedo carrying aircraft, access to the associated technology for controlling the launch of torpedoes from aircraft, and feedback on Japanese designed torpedo aircraft.[173] The Japanese asked for technical information on British torpedoes, but it is unclear if the mission ever provided it.[174] Later in the mission, Brackley conducted experimental work for the Japanese and wrote a report on metal propellers including whether the Japanese should design and manufacture their own or procure them from England.[175] At a minimum, we can say the Sempill Mission provided Japan the

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[169] Ferris, "Armaments and Allies," 262.
[170] R. Vaughan-Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358, pp. 95-96.
[171] Admiralty Letter M.6041 from O. Murray to the Under Secretary of State, Foreign Office, 19 May 1922, TNA: FO 371/8050, F1793/1065/23, p. 9 (Back). Brackley, *Brackles*, 173.
[172] I have found no documented evidence that the Mission provided this specific equipment, but the *Hosho* used British-style arresting gear when completed. Given that the Mission is known to have advised on the construction of the flight deck and trained the Japanese pilots on carrier landings and launches, it is almost certain it was the source of this technology.
[173] Arthur E. Burke, "Torpedoes and Their Impact on Naval Warfare" (Newport, RI: Naval Undersea Warfare Center, 2017), 123, https://apps.dtic.mil/dtic/tr/fulltext/u2/1033484.pdf. Brackley, *Brackles*, 172.
[174] Brackley, *Brackles*, 146–47.
[175] Brackley, 189.

technological foundation for its aircraft carriers and torpedo aircraft – the cornerstone of Japanese naval airpower in the Second World War.

The mission's epilogue is the most surprising. As the mission continued, the Air Ministry officials became totally opposed to its work. In August of 1923, Sempill, now back in Britain, wrote to Brackley that the Air Ministry had prohibited him (Sempill) from sending a report on the latest British technical innovations in naval aviation that he had already written and promised to Brackley.[176] But the strongest evidence of the Air Ministry's turn against Sempill and his mission was its support of a counterintelligence investigation against him in 1924.[177] Sempill's phone was monitored and his correspondence read.[178] He was found to be taking money and gifts from the Japanese – of course, the Japanese had paid him throughout his time with the British Civil Air Mission as well.[179] Eventually, he was called to the Air Ministry where senior members of the Ministry and his MI5 case officer jointly interrogated him.[180] While the conduct for which he was criticized occurred after his return from Japan, it was essentially identical to the methods he had used to collect information in support of the mission. In 1926, as Sempill sought to create another mission for himself in Greece – an independent effort which received some support from the Foreign Office – a meeting occurred at the Foreign Office to review whether to prosecute Sempill for his actions. It included not only the sitting Foreign Secretary and Secretary of State for Air but also many of the same Air Ministry and Foreign Office officials involved in the original Sempill Mission discussion, including Chief of the Air Staff Hugh Trenched as well as

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176 Brackley, 171.
177 "Minutes of a meeting held in D.C.A.S.'s Room at 12.0 Noon 4th. May. 1926," 4 May 1926, TNA: KV 2/871 Document 587A.
178 Counterintelligence Summary of Sempill's Activities from 1 Feb 1924 to 30 Oct 25, No Date, TNA: KV 2/871, Document 573A; Minute 228, 31 July 1924, TNA: KV 2/871.
179 Memo to Major Ball, 25 Mar 1926, TNA: KV 2/871, Document 542A.
180 "Minutes of a meeting held in D.C.A.S.'s Room at 12.0 Noon 4th. May. 1926," 4 May 1926, TNA: KV 2/871 Document 587A.

Victor Wellesley and Miles Lampson of the Foreign Office. While the group decided not to prosecute, it was a close decision. The Foreign Secretary, who chaired the meeting, stated "that in any similar case he would be prepared to support a prosecution."[181]

Out of this history, two distinct periods emerge. During both periods the preferences of the various bureaucracies appear to have been relatively stable, but the Air Ministry's preferences changed between periods. Period I began with the initial discussion of the mission in 1920 and runs through 1923. Late in Period I, the Admiralty did appear to shift away from its opposition to the mission The discussion of the Admiralty's position explains why the changes in Admiralty policy were more likely an effort to make the best of a bad situation rather an increase in its support the mission. Period II begins in 1923 when the mission began to encounter opposition from the Air Ministry in gaining information for the Japanese and includes the time when MI5 opened its counter-intelligence investigation into Sempill's activities.

Scope Conditions

At first appearance the Sempill Mission was about flight and tactical training rather than technology transfer. Undoubtedly, much of the Sempill Mission's effort did focus on skill and doctrine training, but from the beginning, technology transfer was an important part of both the Japanese and British conception of the mission.

I evaluate three questions to assess whether the Sempill Mission meets my theory's scope conditions. First, did technology transfer occur as part of the mission? Second, if technology transfer occurred was it deliberate or did the British at least understand it was likely technology

[181] Minute 593 by Colonel V.G.W. Kell on a meeting at the Foreign Office, 13 May 1926, TNA: KV 2/871.

transfer would occur? Third, was the mission official or at least sanctioned by both governments?

1. Did transfer of advanced technology occur?

At first, it appears the primary focus of the Japanese request that led to the mission was for the British to train Japanese Navy pilots not to provide technology. In general, when outsiders (like the Australian government or the British or the American press) described the mission, they focused on the practical training aspects of the mission. A closer examination, however, shows technology transfer was a core part of the mission. The Japanese requested technological information, and the make-up and general tasks of the mission strongly suggest the importance of technology transfer. Moreover, key documented examples of technology transfer by the mission validate this circumstantial evidence.

While most of the Japanese request for instruction focused on flight and tactical training, it also included requests for technological instruction. The instructions the Japanese Government provided to their Naval Attaché in London called for a mission that would provide training on "Technical Administration, i.e., inspection of machines engines [sic], etc." and "Advice for building Aeroplane Carriers."[182] Moreover, in follow up instructions, the Japanese Navy Department reiterated the importance of expertise in aircraft carrier construction.[183] That the Japanese should have been so interested in the technical details of aircraft carrier construction is unsurprising as the British were considered to have the most advanced aircraft carriers in the world at the time.[184]

[182] Confidential Memorandum from the Japanese Naval Attaché in London, No Date, TNA: FO 371/5358, F2337/193/23, p. 10.
[183] Confidential Letter No. 1133 from K. Nomura to Captain Marriott, 25 Aug 1920, TNA: FO 371/5358, F2516/193/23, p.37.
[184] Hone, Friedman, and Mandeles, *American & British Aircraft Carrier Development, 1919-1941.*, 86–87.

Once the mission arrived, the Japanese made requests for updates on British technology whenever members of the mission made return trips to England. The mission received requests for updated technological developments related to seaplanes, airship navigation, air-dropped torpedoes and torpedo-sights, metallic airplanes, spotting aircraft, steel propellers, and bombs.[185] While it is impossible to know all of the technological information the mission transferred, surviving records confirm the British provided information on aircraft carrier construction, metal propellers, and the development of the Mitsubishi 1MF, 2MR and B1M aircraft.[186] These aircraft would serve with the Japanese naval air arm through the early 1930s. All this information was either cutting-edge or applied R&D.

2. Was the technology transfer deliberate?

It is also clear this transfer of technology was deliberate – that is it was not "stolen" by the Japanese. Before the mission departed, the Air Ministry told British aviation firms they could offer the Japanese their latest equipment, if they made no mention of the Air Ministry's specifications.[187] The makeup of the mission's membership easily facilitated technological transfer. Beyond its pilots, the mission also included officers charged with Armament, Design,

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[185]Brackley, *Brackles*, 146–47.

[186] For evidence on technology transferred see: Admiralty Letter M.6041 from O. Murray to the Under Secretary of State, Foreign Office, 19 May 1922, TNA: FO 371/8050, F1793/1065/23, p. 9 (back)-10; Brackley, 189.; Fowler refers to the Mitsubishi aircraft as the Mk 1, Mk 2, Mk 3, and Mk 4, but based on his descriptions these were the Mitsubishi 1 MF, 2MR, B1M, 1MT respectively. All were designed by British former Sopwith engineers separately hired by the Mitsubishi, but Fowler makes clear that he helped test all but the 1MT as part of the Sempill Mission. Vaughan-Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358, p. 95-96, 101. Despite this evidence, the British Naval Attaché in Tokyo reported at the time that the Japanese never seemed to ask the mission for design evidence. This seems mistaken, though it is also possible the Japanese came to rely on the mission for technical advice more over time. Later, the Japanese Vice Minister of Marine Vice Admiral Ide would specifically the Japanese welcomed technical proposals from the mission, and one of the mission members, writing after he returned to England, commented that the Japanese had invited the mission to help build a Japanese aviation industry. J.P.R Marriott, "Report No. 1 of 1922: Annual Report on the Imperial Japanese Navy," 25 May 1922, TNA: FO 371/8051, F2109/2109/23, p. 80; Frida H. Brackley, *Brackles*, 16; R. Vaughan-Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358, p. 36.

[187] Ferris, "Armaments and Allies," 261.

Engineering, and Rigging. Notably, the Japanese extended only these "technical members" beyond the initial end of the mission in 1922.[188]

Unsurprisingly, given this make up, the mission designed its work to regularly share technical information. Mission members provided technical lectures, noted that the Japanese students were writing textbooks based on the information the mission provided, and suggested the Japanese send their aircraft designers and aeronautical engineers to spend time with the mission.[189] The mission also did what it could to comply with requests for technological information from the Japanese.[190] Even after Sempill returned to England, he wrote Brackley asking him "to keep hammering at technical questions and also … with the experimental programme by ordering some machines of any of the experimental types."[191]

3. Was the technology transfer government-to-government or sanctioned by both governments?

This criterion is, perhaps, the most difficult of the three for the Sempill Mission to meet, but it meets it nonetheless. The "official" decision of the British government was to refuse a mission to train the Japanese Navy and to offer only a "Civil Aviation" mission.[192] Moreover, on multiple occasions, both within the Government and to the public, the British government declared that the mission was unofficial and was outside the control of the British Government.[193] And yet, entities in the British Government issued so many statements attesting

[188] Brackley, *Brackles*, 135.
[189] Brackley, 164–67.
[190] Brackley, 172.
[191] Brackley, 170.
[192] Letter from Victor Wellesley to Baron Gonsuke Hayashi, 12 Nov 1920, TNA: FO 371/5358, F2761/193/23, p.90.
[193] Letter from Frederick Guest to Lord Curzon, 4 Aug 1921, TNA: FO 371/6693, F2930/421/23, p. 218. Clipping from Hansard: "Japan (Air Service)," 23 Mar 1921, TNA: FO 371/6693, F1403/421/23, p. 198; "Question asked in the House of Commons," 14 Apr 1921, TNA: FO 371/6693, F1403/421/23, p. 193.

to the "unofficial" nature of the mission only because it looked so very official. The mission ought to be considered an official government-to-government transfer for three reasons.

First, as previously shown, it took place because of coordination between the Japanese and British Governments.[194]

Second, the Air Ministry effectively selected the leadership of the mission and provided it with information and equipment that it could not have otherwise accessed. General Fredrick Sykes, Controller of Civil Aviation and previously the first Chief of the Air Staff, supplied Sempill's name to the Japanese knowing he was an expert in military and naval aircraft design.[195] Additionally, despite the Air Ministry's strident denials, both Winston Churchill, who was Secretary of State for Air at the time the mission was formed, and members of the mission would both record that the mission received "unofficial" assistance from the Air Ministry.[196]

Third, when Sempill tried to arrange a similar mission to Greece on his own, the Air Ministry criticized him for doing so, provided no support, and specifically contrasted the situation with the Japanese mission. When brought in to discuss his potential mission to Greece an Air Ministry representative said:

> As you remember, the Japanese question was on a different basis. There was some definite reason for not having a service mission in Japan, and because of this reason it was agreed to send a civil one. This does not exist in Greece…. Our general policy is that if we are asked to help some foreign power the best way is through one of our own officers, which is quite natural.[197]

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[194] Letter from the Japanese Ambassador in London to Lord Curzon, 6 Oct 1920, TNA: FO 371/5358, F2334/193/23, p. 6; Confidential Letter No. 1133 from K. Nomura to Captain Marriott, 25 Aug 1920, TNA: FO 371/5358, F2516/193/23, p.37. Minute by B.C. Newton, 12 Oct 1920, TNA: FO 371/5358, F233/193/23, p. 5. Note by Lord Curzon, 8 Nov 1920, TNA: FO 371/5358, F2761/193/23, p. 84; Letter from Mr. Nagai to Lord Curzon, 30 Nov 1920, TNA: FO 371/5358, F2992/193/23, p. 111. Letter from Victor Wellesley to M. Nagai, 22 Dec 1920, TNA: FO 371/5358, F3188/193/23, p. 125.

[195] Letter from Frederick Guest to Lord Curzon, 4 Aug 1921, TNA: FO 371/6693, F2930/421/23, p. 218.

[196] Private Letter from Winston Churchill to Lord Curzon, 13 July 1921, TNA: FO 371/6693, F2577/421/23, p. 207; Brackley, *Brackles*, 169.

[197] Minutes of a meeting held inf D.C.A.S.'s Room, Air Ministry, on 6.5.26," 6 May 1926, TNA: KV 2/871, Document 588A, p. 2.

Of course, the "definite reason for not having a service mission in Japan" was Admiralty opposition to the undertaking! Nonetheless, the point remains that the Air Ministry essentially admitted that what Sempill was proposing to do in Greece was identical to what occurred in Japan: the key difference being that in the Japanese case there was a reason an "official" mission could not be sent, but the Air Ministry still wanted to provide support.

It is worth pausing for a moment to assess, how the Air Ministry could create a mission to transfer naval aviation technology to Japan when the official decision prohibited it. The effort was a master course in bureaucratic skullduggery. First, the Air Ministry went its way to gain authorization for a "civil" aviation mission from the Foreign Office and Admiralty as a face-saving tactic after the government rejected the naval mission. Then, as now, "civil" aviation describes activities like commercial air travel, flying clubs, and private flights. It does not include any military or naval activity. Second, the Air Ministry deliberately obfuscated language around the mission. It exploited the similarity in the words "civil" and "civilian." It organized a mission of former Royal Navy and Royal Air Force pilots who were now civilians to train the Japanese in naval aviation. It called this civilian mission, a "civil" mission – which it decidedly was not. Third, the Air Ministry outsourced as much of the mission's organization to the Japanese, the Vickers Company, and Sempill as possible, so that it could maintain plausible deniability about its activities.[198] As a result, when anyone complained about the mission, the Air Ministry could deny it had control over what was going on even as it could still say the mission was only "civil" and "unofficial" and that other ministries had also authorized it. Responsibility for the mission vanished. That the Air Ministry controlled all British government aviation – naval, military, and civil – no doubt helped it avoid scrutiny from other ministries as well.

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[198] Ferris, "Armaments and Allies," 261.

Theory Evaluation - Ministry Positions on Allowing the Mission

In this section, I use the Sempill Mission to test TOTT. A challenge arises in evaluating my theory in this case because the Sempill Mission combined skill and doctrine training with technology transfer. Thus, at times some ministries saw the benefits of a skill and doctrine training mission even if there were few benefits to technology transfer. Despite this occurrence, as we have seen, all the ministries acknowledged technology transfer was part of the mission, thus TOTT should still generate appropriate predictions. Some ministries, however, had reasons to support sending the mission that involved training and technology sharing that they might not have had with a technology transfer only mission. I identify those situations below. In general, however, in situations where my theory predicts restraining influences on technology sharing, if those restraining effects still occur despite the presence of additional reasons to send the mission, the test should still validate my theory. That is, if the non-technology portions of the mission created additional reasons for sending the mission, but ministries still did not support sending the mission, that should serve as evidence in support of my theory.

Foreign Office

1. What motivations, if any, did the Foreign Office have to share technology?

Throughout their evaluation of the decision to send the mission, Foreign Office officials in London discussed two reasons for potentially sending it to Japan. First the mission might produce a commercial advantage. When the interdepartmental committee met on 15 October to discuss the mission, Victor Wellesley, representing the Foreign Office, stated that his office viewed "the question primarily from a commercial point of view" and that "the Overseas Trade

Department were anxious for the mission to go."[199] Teaching the Japanese to fly naval/amphibious aircraft could have created demand for purchases of these types of planes from British manufacturers, but the only aircraft the Japanese promised to purchase were those required to outfit the mission.[200]

Second, the Foreign Office saw political value to the mission. They saw the mission as having potential to increase British prestige and wanted to avoid offending the Japanese. When the Japanese first formally proposed the mission, the Foreign Office wrote to the other involved ministries that "from the political point of view" it "considered [the mission] desireable."[201] When the Japanese continued to push for the mission after the Foreign Office initially stated that Britain would be unable to provide one, the Foreign Office again discussed this reasoning. In December, B.C. Newton noted that "the Japanese seem[ed] to attach real political importance to the question," and worried they "might draw undesirable conclusions" if the British did not accede.[202] These types of arguments featured in the Foreign Secretary's communications with other departments as well. The Foreign Office did not directly expect to gain anything for Britain if it provided the mission to the Japanese, but it felt Britain may have gained status and protected its relationship with the Japanese.

2. How did the Foreign Office assess Britain's future interest alignment with Japan?

The Foreign Office expected that Japan might become a threat in the future. Roughly six months before the Japanese made their request for what would become the Sempill Mission, the

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[199] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 40.
[200] The Japanese did dangle the potential for future sales. Japanese Embassy Memo "Dispatch of British Service Air Officers to Japan for Instruction," 25 Nov 1920, TNA: FO 371/5358, F2941/193/23, p. 102.
[201] Japanese Embassy Memo "Proposed British Air Mission to Japan to instruct Japanese Naval Air Service,"30 Nov 1920, TNA: FO 371/5358, F2992/193/23, p. 107 (Back).
[202] Minute by Miles Lampson, 2 Dec 1920, TNA: FO 371/5358, F2992/193/23, p.105B (Back).

Foreign Office undertook a review of the Anglo-Japanese Alliance, which would be up for renewal in 1921. Many of the same Foreign Office leaders and Far East hands involved in the discussion of the Sempill mission participated in this review. Even after revisions which toned down its language, the review made decidedly pessimistic predictions for Anglo-Japanese relations. It noted that "the interests of Great Britain … are often in conflict with those of Japan" before listing seven separate areas in which these conflicts of interest occurred.[203] These conflicts included concern about future Japanese threats to both British commercial interests and territorial possessions in China and the Pacific. The review assessed that Japan "menace[d] [British] positions in Hong Kong, the Straits Settlements and the Pacific Islands."[204] The author even compared the Japanese to the recently defeated Germans in their jealousy of the British Empire and their desire for "a place in the sun."[205]

Conversely, Foreign Office's strongest argument for continuing the alliance sat squarely within the British tradition of appeasing rising powers: Britain could not afford to respond to an unrestrained, hostile Japan.[206] It is worth quoting the "Case for Renewal" at length,

> If the Alliance were not renewed, we [the British] should find ourselves confronted with a suspicious and possible hostile Japan which would cause us considerable embarrassment in China, India and the Far East generally. Owing to our recent need of economy and the increasing naval strength of Japan, it is not possible for us to maintain forces in the Far East sufficient to support a strong policy involving a possible coercion of Japan, or even a fleet equal to in size to hers. We should be unable to guarantee the safety of Hong Kong, Wai-hai Wei and the Pacific Islands; even Singapore might possibly be in danger in the event of trouble. Such a situation cannot be contemplated with equanimity, and the only alternative to maintaining in

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[203] "Memorandum by Mr. C.H. Bentinck on the Effect of the Anglo-Japanese Alliance upon Foreign Relationship," 28 Feb 1920, TNA: FO 371/5358, F199/199/23, p. 160. While the memo was written by Mr. Bentinck it was edited and approved up through the Foreign Secretary.
[204] "Memorandum by Mr. C.H. Bentinck on the Effect of the Anglo-Japanese Alliance upon Foreign Relationship," 28 Feb 1920, TNA: FO 371/5358, F199/199/23, pp. 160-1.
[205] "Memorandum by Mr. C.H. Bentinck on the Effect of the Anglo-Japanese Alliance upon Foreign Relationship," 28 Feb 1920, TNA: FO 371/5358, F199/199/23, pp. 160-1.
[206] Paul Kennedy, "The Tradition of Appeasement in British Foreign Policy 1865-1939," *British Journal of International Studies* 2, no. 3 (October 1976): 195–215.

> the Pacific a fleet capable of dealing with Japan would appear to be renewal of the alliance.[207]

The irony of renewing the alliance to restrain the Japanese from threatening the British Empire was not lost on those considering the debate. Some officials argued against the ability to continue a lasting alliance on such grounds.[208] One official who advocated for a wait-and-see approach on the belief that Japanese domestic politics might soon produce a less militaristic foreign policy found himself facing several counterarguments.[209]

These assessments were reinforced by information gathered by the Special Intelligence Service (SIS). In late March, the Foreign Office received a report on a conversation with a Japanese naval official as to Japan's relations with Germany. This official stated that Japan had gone to war with Germany not because the Germans were "enemies" but because the Japanese sought to expel all Europeans from China. He went on to say "Later on, we shall see to having English possessions, and American, such as HONG-KONG, WEI-HAI-WEI and the PHILIPPINES. As soon as a new war breaks out, we must make use of the opportunity to retake what belongs to us from a historical and military point of view."[210] Without a doubt, the Foreign Office saw Japan as a potential future threat, one it was already attempting to take policy actions to mitigate.

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[207] "Memorandum by Mr. C.H. Bentinck on the Effect of the Anglo-Japanese Alliance upon Foreign Relationship," 28 Feb 1920, TNA: FO 371/5358, F199/199/23, p. 161 (Back).

[208] E.M Hobart Hampden, "The Alliance and Internal Conditions in Japan," 28 Mar 1920, TNA: FO 371/5358, F304/199/23, p.188 (Back).

[209] For advocacy for wait-and-see, see "Minute by Mr. F. Ashton-Gwatkin on the Anglo-Japanese Alliance and Constitutional Changes in Japan" 23 Mar 20, TNA: FO 371/5358, F304/199/23, p.191. For the response to his argument, see Minute by C.H. Bentinck, 26 Mar 1920, TNA: FO 371/5358, F304/199/23, p.192; E.M Hobart Hampden, "The Alliance and Internal Conditions in Japan," 28 Mar 1920, TNA: FO 371/5358, F304/199/23, p.188 (Back).

[210] Political Report from Geneva CX/LGHVS/645/E. 841 PA/395, 22 Feb 1920, TNA: FO 371/5358, F198/198/23, p.144.

3. Did the Foreign Office express concerns about the ability of the recipient state to protect technological secrets?

No. At no time did the Foreign Office discuss this concern.

4. Did the Foreign Office assess the pace of innovation in the technological area under consideration? If they did, did they assess the pace of innovation as unusually quick?

No. The Foreign Office representatives did not discuss the specifics of the technologies under discussion.

In summary, the Foreign Office considered supporting the mission for economic and diplomatic reasons, but did not see any threats, international or organizational, which sharing technology with Japan would help mitigate. The Foreign Office viewed Japan as a potential future threat and did not assess the pace of innovation. Given these conditions TOTT predicts that the Foreign Office should have supported a technology sharing policy of "None."

What policy did the Foreign Office adopt? It opposed technology transfer. Initially, it appeared the Foreign Office might support the Japanese request. A lower-level official proposed drafting an affirmative reply, but he was told to wait until the interdepartmental conference on October 15th.[211] Later during one of the several episodes in which the Foreign Office responded to questions about the mission, officials stated that while they favored the mission from "purely political considerations" the naval concerns led to opposition.[212]

Moreover, the argument that led the Foreign Office to its final position aligns with TOTT. Foreign Office officials recognized the benefits of sending the mission to Japan but were restrained by their concern of Japan as a future threat. While some lower ranking officials

[211] Minute by E.A. Walker, 8 Oct 1920, TNA: FO 371/5358, F2334/193/23, p. 5.
[212] Minute by B.C. Newton, 18 July 1921, TNA: FO 371/6693, F2577/421/23, p. 205.

attributed the Foreign Office's position as pure deference to the Admiralty's opposition, more senior officials were clear that it was the Admiralty's *argument* about the risks sharing naval aviation secrets with Japan would create that changed their minds. Victor Wellesley wrote, "neither the political or commercial advantages are sufficiently great to justify opposition on our part to the overwhelmingly strong argument of the Admiralty [and] W[ar] O[ffice]."[213]

Once the Foreign Office came to oppose sending the mission it never wavered, even as it tried to find ways to minimize the political fallout with the Japanese. The Foreign Office offered the civil aviation mission, but Foreign Office officials later described their initial position on that alternative as "quite luke-warm," and they were not involved in organizing the Sempill Mission.[214] Though the Japanese pressed the Foreign Office the political and commercial advantages of sending an aviation mission – the issues within its purview – the Foreign Office remained opposed. Indeed, when Lord Curzon reviewed the issue after the final Japanese request, the message the Foreign Office sent the Admiralty asking if their position had any flexibility specifically stated that Lord Curzon did not want to press the Admiralty on the issue despite the political desirability of finding a solution.[215] Internal discussion of the issue noted that the British should try and "satisfy the Japanese" if they could find a way to do so "without really endangering our naval and air strategy."[216]

Admiralty

1. What motivations, if any, did the Admiralty have to share technology with Japan?

None. At no time during the discussions of the Sempill Mission did the Admiralty express support for sharing naval or military air technology with the Japanese. Indeed, the

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213 Minute by Victor Wellesley, 17 Oct 1920, TNA: FO 371/5358, F2337/193/23, p7 (Back).
214 Minute by Miles Lampson, 20 Jul 1921, TNA: FO 371/6693, F2577/421/23, p. 206.
215 Letter from Victor Wellesley to the Secretary of the Admiralty, 4 Dec 1920, TNA: FO 371/5358, F2992/193/23, p.120.
216 Minute by B.C. Newton, 1 Dec 1920, TNA: FO 371/5358, F2992/193/23, p.120.

chance the Japanese could gain such technology consistently concerned the Admiralty. Though the Admiralty's Royal Naval Air Service had been subsumed into the Air Ministry's Royal Air Force during the First World War, the Admiralty repeatedly claimed that air technology would be vital to the success of British naval superiority. At the interdepartmental conference, the Assistant Chief of the Naval Staff noted that "Air questions…entered vitally into all Naval technical questions." He deemed that providing the Japanese British Naval technology would "be giving the Japanese the key to [British] Naval policy."[217] That the Admiralty expected that it would need to rely on technical advantage, rather than a large fleet size, for naval advantage heighted this concern. At the same conference, Admiral Beatty noted that "Great Britain would in the future have no great superiority in force over possible enemy nations."[218] Later in December, when the Admiralty was asked to reconsider the question they again noted that "with a reduced Navy, every advantage must be obtained from our superiority in technical work."[219] In short, not only did the Admiralty lack any motivation to support technology transfer to Japan, it had reasons for great caution with technology transfer.

2. How did the Admiralty assess Britain's future interest alignment with Japan?

The Admiralty saw Japan as a potential future enemy. As early as October 1919, the Admiralty began to assess its position in the Far East for a potential conflict with Japan. In a report for the War Cabinet, the Admiralty evaluated potential Far East scenarios should the Anglo-Japanese Alliance not be renewed in 1921. While the report analyzed wars with

[217] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, pp. 41-2.
[218] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 43.
[219] Admiralty Letter M.03338 to the Under Secretary of State, Foreign Office, 11 Dec 1920, FO 371/5358, F3188/193/23, p. 122.

several potential alignments of Pacific powers including an alliance with the United States, the enemy was always Japan.[220] Similarly, when the Foreign Office solicited Admiralty and War Office perspectives on renewing the Anglo-Japanese Alliance in early 1921, the Admiralty was the only one of the three ministries to recommend against renewal, writing that the Admiralty considered "a continuation of the alliance in its present form neither necessary nor desirable."[221] The Admiralty took this stance even as it recognized the same risks to ending the alliance with Japan as did the other ministries.

Thus, it is no surprise that the Admiralty also expressed this view when considering the potential of sending a naval aviation mission to Japan. When Admiral Beatty stated his view that Britain would have no superiority in force numbers against "possible enemy nations" at the 15 October conference, he then added "including Japan."[222] The Admiralty clearly viewed Japan as a potential future opponent.

3. Did the Admiralty express concerns about the ability of the recipient state to protect technological secrets?

No. At no time did the Admiralty discuss this concern.

4. Did the Admiralty assess the pace of innovation in the technological area under consideration? If they did, did they assess the pace of innovation as unusually quick?

No. Admiralty officials – none of whom that participated in the decision-making had experience with aviation technologies – made no assessments about the pace of technological innovation.

[220] "Naval Situation in the Far East," 21 Oct 1919, TNA: ADM 1/8571/295 pp. 2-5.
[221] Letter from Admiralty (O. Murray) to Foreign Office, 14 Feb 1920, FO 371/5358, F199/199/23, p.165.
[222] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 43.

Overall, the Admiralty expressed no reasons to share technology with Japan and had reasons to believe sharing naval aviation technology would put it at a disadvantage. The Admiralty viewed Japan as a potential future threat. Given these positions, my theory predicts that the Admiralty should have taken a technology sharing policy of "none."

The Admiralty took this stance. The Admiralty already opposed sharing information with the Japanese on other issues. In 1917, while still fighting the war, British Naval Intelligence instructed British factories producing naval material to show "nothing of a confidential nature" to the Japanese.[223] After the war, the Admiralty refused to resume the pre-war exchange of officers with the Japanese.[224] In the case of the Sempill Mission, the Admiralty opposed transferring technology to the Japanese from the beginning. When the Air Ministry proposed holding an interdepartmental meeting to coordinate the British government's answer, the Admiralty leapt at the chance to chair it.[225] In the meeting, the Admiralty aggressively pushed its argument. Wellesley even included the Admiralty's argument in his report: "in all future wars aviation will be of the first importance to both branches of the national forces" and providing the Japanese with British "secrets … would be a serious blunder [and] potential danger."[226] The Admiralty was willing to permit a civil aviation mission – a mission that would "merely …[teach] the Japanese how to fly."[227] Later the Admiralty would characterize its position on the civil mission as allowing "a lesser evil."[228] Such a mission would do little to increase Japanese

[223] Ferris, "Armaments and Allies," 258.
[224] Towle, *From Ally to Enemy*. p. xvi.
[225] Admiralty Letter M.02980 from W.H. Hancock to the Secretary, Air Ministry, 7 Oct 1920, TNA: FO 371/5358, F2337/193/23, p. 12.
[226] Minute by Victor Wellesley, 17 Oct 1920, TNA: FO 371/5358, F2337/193/23, p. 7 (Back).
[227] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 40.
[228] Admiralty Letter M.01025 from Charles Walker to the Under Secretary of State Foreign Office, 2 Oct 1922, TNA: FO 371/8050, F3117/1065/23, p. 23.

capability in a fight since it would involve no technology transfer, but it would allow both the British and the Japanese to save face.

The Admiralty maintained this position throughout most of the mission, even as it paid little attention to it. When the Admiralty did realize what had happened shortly after Captain Marriott returned from his tour as naval attaché in Tokyo, it immediately repeated its opposition. In May 1922, the Admiralty sent a strident complaint to the Foreign Office about what the Sempill Mission had become and asserted someone must have circumvented the official decision. It believed the mission was "employed in the type of work that the Admiralty specially objected to."[229] It demanded that the Foreign Office attempt to stop any continuation of the mission and make an effort "to prevent the further disclosure by similar means of British ideas and technical details in Naval aviation."[230] Clearly, the Admiralty still felt strongly about the issue, and no evidence suggests its evaluations of the importance of the technology, the Japanese, or the pace of innovation had changed.

Thus, it is surprising, that when the Admiralty re-asserted its objection in early October, it asked for the Foreign Office to take no further action on this issue, except to ask that Sempill call at the Admiralty upon his return to England.[231] More surprisingly, six weeks later, after a conference with the Air Ministry, the Admiralty seemed to make a complete about-face.[232] It now preferred that no warnings be given to the mission about what information they should or should not share with the Japanese, dropped its objections to the continuance of the mission, and stated

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[229] Admiralty Letter M.6041 from O. Murray to the Under Secretary of State Foreign Office, 19 May 1922, TNA: FO 371/8050, F1793/1065/23, p. 9 (Back).

[230] Admiralty Letter M.6041 from O. Murray to the Under Secretary of State Foreign Office, 19 May 1922, TNA: FO 371/8050, F1793/1065/23, p. 10.

[231] Admiralty Letter M.01025 from Charles Walker to the Under Secretary of State Foreign Office, 2 Oct 1922, TNA: FO 371/8050, F3117/1065/23, p. 23.

[232] Admiralty Letter M.01519 from Charles Walker to the Under Secretary of State Foreign Office, 17 Nov 1922, TNA: FO 371/8050, F3821/1065/23, p. 27.

it did not want the Naval Attaché in Tokyo to seek to obtain information from the mission.[233] The Admiralty even dropped its request to have Sempill visit.[234]

What happened? TOTT does not predict any shift in the Admiralty's position vis-à-vis sharing technology. While the evidence as to what triggered the Admiralty's change is circumstantial at best, the evidence that does exist suggests that the Admiralty did not change its position on the desirability of technology sharing with the Japanese but rather changed its strategy as to how to best prevent further damage from occurring.

As the Foreign Office and the Embassy in Tokyo were quick to point out, suddenly calling the supposedly unofficial mission home was likely to create steep political costs. The Washington Conference, at which the Japanese had accepted a lower limit on the size of their navy than either the British or the American navies, had just concluded. The conference had also seen the Anglo-Japanese alliance replaced by the Four Power Treaty. While Britain, the United States, France, and Japan pledged not to fortify most of the possessions in the Pacific and to respect the status quo in Asia, the treaty contained no formal security guarantees and was thus a much weaker instrument. The Foreign Office and Tokyo Embassy were quite concerned that in this context the sudden withdrawal of a mission-in-progress would give the Japanese an impression of British hostility.[235] The Foreign Office made this point to the Admiralty.[236]

These reports fit well with the Admiralty's strategic perspective. Admiral Beatty had left the Washington Conference convinced that Japan, unrestrained by the Anglo-Japanese Alliance,

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[233] Admiralty Letter M.01519 from Charles Walker to the Under Secretary of State Foreign Office, 17 Nov 1922, TNA: FO 371/8050, F3821/1065/23, p. 27.

[234] As a result, we have not direct record of Sempill discussing the information he shared with the Japanese. Admiralty Letter M.01519 from Charles Walker to the Under Secretary of State Foreign Office, 17 Nov 1922, TNA: FO 371/8050, F3821/1065/23, p. 27.

[235] Letter from B.C. Newton to the Secretary of the Admiralty, 7 Jun 1922, TNA: FO 371/8050, F1793/1065/23, p. 14; Private Letter from C. Eliot to William Tyrrell, 21 Jul 1922, TNA: FO 371/8050, F1793/1065/23, p. 20.)

[236] Letter from B.C. Newton to the Secretary of the Admiralty, 7 Jun 1922, TNA: FO 371/8050, F1793/1065/23, p. 14.

would rapidly become a threat to British interests in the Pacific.[237] He also knew, however, that Britain was unready to face a conflict with Japan. It would take two months steaming from the start of a conflict before the entire British fleet could consolidate in Singapore, and that port was not yet fortified.[238] Antagonizing the Japanese at this moment would be unwise.

Second, London had received several reports that the Japanese appeared to be learning little from the mission. Captain Marriott, whose return to London prompted the Admiralty's complaints, had continuously provided negative evaluations of the Japanese ability as flyers.[239] These evaluations matched, and indeed, were mostly drawn from Sempill's. He also came to have low expectations for Japanese naval aviation.[240] The Foreign Office highlighted these reports to the Admiralty.[241] Additionally, Captain Colvin, who replaced Marriott as naval attaché in Tokyo, assessed that "the worst of the mischief [had] been done" even as he doubted that any actual naval technical details had been divulged.[242] By the time the Admiralty withdrew its request to prevent any continuation of the mission, Sempill was already on his way back to Britain.[243] This evidence suggests that upon further investigation the Admiralty may have realized that less technology transfer had occurred than they initially believed or that they recognized that they were trying to close the barn after the horse was already out.

Moreover, it appears the Admiralty prioritized preventing further requests for information. After meeting with the Air Ministry, the Admiralty was assiduous about trying to

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[237] Donald Liso, *British Naval Supremacy and Anglo-American Antagonisms, 1914-1930*, Online Edition (Cambridge: Cambridge University Press, 2014), DOI: https://doi.org/10.1017/CBO9781107297890.004.
[238] Liso.
[239] J.P.R. Marriott, "Report No. 8 of 1921, Subject: Civilian Air Mission in Japan, 3 Nov 1921, TNA: FO 371/6693, F4649/421/23, p. 224; J.P.R Marriott, "Report No. 2 of 1922 Subject: British Naval Air Mission in Japan," TNA: FO 371/8050, F1065/1065/231, pp. 1-6.)
[240] Private Letter from C. Eliot to William Tyrrell, 21 Jul 1922, TNA: FO 371/8050, F1793/1065/23, p. 19A.
[241] Letter from B.C. Newton to the Secretary of the Admiralty, 7 Jun 1922, TNA: FO 371/8050, F1793/1065/23, p. 13.
[242] Private Letter from C. Eliot to William Tyrrell, 21 Jul 1922, TNA: FO 371/8050, F1793/1065/23, p. 19 (Back).
[243] Brackley, *Brackles*, 168.

maintain the "unofficial nature of the mission" – a point the Air Ministry had repeatedly made.[244] The Air Ministry likely highlighted the arguments that it had made previously: that the mission was unofficial and that it had issued specific instructions that the mission was to have no special access to information.[245] By 1922, this should have meant that the mission's information was at least two years old. To this end, the Admiralty stated it did not want information obtained through the mission but only "through the usual channels." Additionally, it requested that "care … be taken not to endeavour to obtain data that would lead to demands by the Japanese for reciprocal information."[246] These restrictions are especially noteworthy because they were costly. They meant the Admiralty might give up information about the progress the Japanese were making in naval aviation.[247] Thus, even as it appeared to withdraw its objections to the mission, the Admiralty was particularly careful to guard against any situation which could place it in a position where the Japanese might make further requests for information. Moreover, while the Admiralty withdrew its specific complaints about the mission, it never withdrew its request that the Foreign Office prevent similar disclosures of information from happening in the future. Rather than changing its position on the desirability of the mission, the seeming withdrawal of the Admiralty's demand to end the mission seems to have been an effort to make the best of a bad situation and protect against further sharing of information.

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[244] Admiralty Letter M.01519 from Charles Walker to the Under Secretary of State Foreign Office, 17 Nov 1922, TNA: FO 371/8050, F3821/1065/23, p. 27.
[245] "Civilian Air Mission to Japan" Summary, TNA: FO 371/6693, F2930/421/23, p. 216.
[246] Admiralty Letter M.01519 from Charles Walker to the Under Secretary of State Foreign Office, 17 Nov 1922, TNA: FO 371/8050, F3821/1065/23, p. 27.
[247] The idea of the mission as a source of intelligence on the Japanese surfaced from time to time. For example, in Private Letter from C. Eliot to William Tyrrell, 21 Jul 1922, TNA: FO 371/8050, F1793/1065/23, p. 19 (Back), though this letter almost certainly was not shown to the Admiralty. The Air Ministry had made this point in the interdepartmental conference. See "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 41.

War Office

Though it had less of a stake in the issues at hand, the War Office position was like the Admiralty's. As such, less information exists on the War Office position. Indeed, by November 1920 it basically removed itself from the discussion by stating that it would support whatever decision the Air Ministry and Admiralty came to since they were the primarily affected ministries.[248] Nonetheless, the War Office participated in the early discussions surrounding the mission, so it is worth examining briefly.

1. What motivations, if any, did the War Office have to share technology with Japan?

None. Indeed, like the Admiralty, if anything, the War Office seemed to hold the opposite position. Victor Wellesley noted that the War Office too believed that aviation would be of key influence in future conflicts creating a need to protect British secrets.[249]

2. How did the War Office assess Britain's future interest alignment with Japan?

Like the other ministries of the British government, the War Office appeared to believe that Japan would become a future threat. When asked for comment on the renewal of the Anglo-Japanese alliance, the War Office supported renewing the alliance. Like the Foreign Office, however, the War Office sought renewal to restrain Japan. The Army Council noted that "some form of alliance or understanding with Japan" was needed "because … it [was] clear that [the British] military position in the Far East might be most embarrassing, to say the least of it, in the event of hostilities with Japan."[250] The War Office was also concerned the Japanese might join a "Russo-German combination" if left without a relationship with Britain.[251] During the

[248] War Office Letter 027/974 (M.I.R) to the Under Secretary of State Foreign Office, 3 Nov 1920, TNA: FO 371/5358, F2763/193/23, p.94.
[249] Minute by Victor Wellesley, 17 Oct 1920, TNA: FO 371/5358, F2337/193/23, p. 7 (Back).
[250] Letter from War Office (B.B. Cubitt) to Foreign Office, 14 Feb 1920, TNA: FO 371/5358, F199/199/23, p.164.
[251] Letter from War Office (B.B. Cubitt) to Foreign Office, 14 Feb 1920, TNA: FO 371/5358, F199/199/23, p.164.

interdepartmental conference, the War Office agreed with the Admiralty position that Japan could become dangerous.[252] The War Office viewed Japan as a potential threat.

3. Did the War Office express concerns about the ability of the recipient state to protect technological secrets?

   No. At no time did the War Office discuss this concern.

4. Did the War Office assess the pace of innovation in the technological area under consideration? If they did, did they assess the pace of innovation as unusually quick?

No. The War Office did not specifically discuss the nature of aviation technology.

While information on its position is scant, the War Office does not appear to have any motivation to share technology with Japan, it viewed Japan as a potential threat, and it did not have a shortened time horizon. Given these positions, TOTT predicts that the War Office should have adopted a technology sharing policy of "none."

In the end, the War Office took this position. When the War Office was initially consulted on the potential of a mission to train the Japanese in naval aviation, however, it stated that it "concurred" that it would be desirable to send a mission.[253] By the time the interdepartmental conference occurred ten days later, however, the War Office had reversed its position. The official record of the meeting does not include a definitive position on the part of the War Office, though the Director of Military Intelligence did repeatedly try to help the two sides find compromise. Victor Wellesley's notes of the meeting, however, state the War Office, was "strongly opposed" to the mission.[254] This position matches TOTT's prediction.

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[252] Minute by Victor Wellesley, 17 Oct 1920, TNA: FO 371/5358, F2337/193/23, p. 7 (Back).
[253] War Office Letter 027/974 (M.I.R) from B. B. Cubitt to the Under Secretary of State Air Ministry, 5 Oct 1920, TNA: FO 371/5358, F2333/193/23, p. 4.
[254] Minute by Victor Wellesley, 17 Oct 1920, TNA: FO 371/5358, F2337/193/23, p. 7 (Back).

The position the War Office took on sharing other types of technology with Japan also coincides with TOTT's prediction. The War Office was cautious in providing advanced technological information to the Japanese in the areas over which it had primary responsibility. In particular, while the War Office generally allowed the Japanese military attaché the ability to visit British Army facilities – a standard practice amongst allies at the time – it refused access to "the Staff College, the Gas School and the Tank School."[255] While one-off attaché visits should not be considered technology transfer, it is notable that the War Office still refused this sort of access to information regarding the two key ground warfare technologies that emerged from the First World War. While only scant data exists on the opinions of the War Office regarding the mission, the positions it took align with TOTT's predictions.

Air Ministry

The Air Ministry's position is the most important to evaluate because the Air Ministry ignored the official decision to prohibit a mission that would provide naval aviation training by helping the Japanese organize an "unofficial" "civilian" mission composed of former RAF personnel.

1. What motivations, if any, did the Air Ministry have to share technology with Japan?

Like the Foreign Office, the Air Ministry had an economic and an organizational reason to send the mission. The Air Ministry principally supported the training mission on economic grounds: It thought it would help support the British Aviation industry.[256] Indeed, at the interdepartmental conference, Trenchard noted that the Air Ministry's support for the mission was "primarily on behalf of civil aviation" and that though Air staff preferred the mission to go it

[255] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 40.
[256] "Proposed British Naval Air Mission to Japan," 1 Dec 1920, TNA: FO 371/5358, F2992/193/23, p. 107 (Back).

"did not wish to press the matter."[257] Indeed, "air missions, representatives, and demonstration flights abroad" were a recommendation of the Civil Aviation side of the Air Ministry as a way to "keep commercial aviation alive" in 1921.[258] This reasoning was further re-enforced by Trenchard's concern about potential French competition for to provide the mission.[259] Though these brief mentions do not hint at the serious situation in which both the Air Ministry and British aviation found themselves in the years after the First World War.

The precariousness of the Air Ministry, the RAF, and British Aviation in general is perhaps best described by historian Peter Reese, who – in his book on the history of inter-war British aviation – titled the chapter on the period from 1919 to 1926 "Backs to the Wall." The British Government had created the Air Ministry and RAF in April 1918 through the amalgamation of the British Army's Royal Flying Corps and the Admiralty's Royal Naval Air Service. It was the world's first independent air force. When the war ended, it was by no means clear that the government would not dissolve the Air Ministry and the RAF as it was doing with other wartime ministries. Indeed, in the first post-war government, Prime Minister David Lloyd

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[257] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 42.

[258] Frederick Hugh Sykes, *From Many Angles; an Autobiography* (London: G.G. Harrap & Company Ltd, 1942), 294.

[259] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 41. How much did the specter of French competition affect the British decision to send the Sempill Mission? Had the French gained sent a mission instead of the British, it could have helped the French relative to the British in two ways. One it could have given the French more influence over Japanese naval policy by ingratiating themselves with the Japanese at the expense of the British. While British officials in Japan considered this a possibility, officials in London did not mention the mission as a way to gain general influence, and the message from Tokyo arrived too late to influence the discussions. Moreover, the Air Ministry's later insistence that the mission was unofficial and their general lack of later interest in the mission suggests this rationale was never that important. The other way the French could have gained would have been by shutting out the British from the sale of aircraft as part of the mission and potential future sales. But the British would not have gotten aircraft sales as part of the mission had they chosen not to send it regardless of French competition, and the British believed the French training and product were generally inferior, and the Japanese agreed. Altogether this suggests that the specter of French competition probably had little to do with the final decision. "Proposed British Air Mission to Japan to instruct Japanese Naval Air Service," 30 Nov19 20, TNA: FO 371/5358, F2992/193/23, p.108-108B; J.P.R Marriot, "Employment by Japanese Admiralty of Officers of Royal Air Force to teach Sea Flying," TNA: FO 371/5358, F2516/193/23, p. 33; Derek James, *Gloster Aircraft since 1917*, Second Edition (London: Putnam, 1987), 76–77.

George appointed Winston Churchill to both the War Office and the Air Ministry simultaneously, in part, because he intended to merge the two ministries.[260]

As it was, the RAF was shrinking rapidly. At the end of the war, the RAF had consisted of 22,647 aircraft, 30,122 officers, and 253,410 enlisted organized in 198 squadrons.[261] By 1920, the RAF had just 28 squadrons and about 35,000 personnel of which 1,500 were officers.[262] Tens of thousands of aircraft and engines were disposed of. All of this made it seem as if the RAF might shrink to nothing. Not until December 1919 did the Government agree in principle that the RAF was a permanent organization. Even this victory, however, was not assured. Both the British Army and the Royal Navy continued to resist the existence of an independent air force.[263]

The British aviation industry was in trouble too. The end of the war had brought steep cuts in orders. The downsizing of the RAF had only worsened the supply glut. Facing cuts in orders and a tax on wartime windfall profits, Sopwith, which had produced more than 16,000 aircraft during the war including the ubiquitous Camel, was forced out of business in September 1920 when its attempt to pivot to produce civilian aircraft and motorcycles failed. And Sopwith had been one of the better positioned firms at the end of the war.[264]

Sopwith was just the most famous example. When the Society of British Aircraft Constructors (SBAC) was formed in 1916 it had 40 firms as members, and four more would join during the war.[265] Shortly after the end of the war the number was down to 35 and it would fall to

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[260] Richard Overy, *The Birth of the RAF, 1918: The World's First Air Force* (London, UK: Allen Lane, 2018), 85.
[261] Overy, 80–83.
[262] Overy, 84.
[263] Overy, 93–95.
[264] Peter G. Dancey, *British Aircraft Manufacturers since 1909* (Stroud, Gloucestershire: Fonthill, 2014), 2885. The Sopwith engineering team would go on to found the Hawker Company.
[265] Peter Reese, *Transforming the Skies: Pilots, Planes and Politics in British Aviation, 1919-1940* (Stroud, Gloucestershire: The History Press, 2018), 3.

half its original membership within a few years.[266] Several firms were forced to consolidate or were taken over by defense conglomerates. Others supplemented their aviation business through the manufacture of car bodies and other goods, or even using hangers for farming.[267] Support from the Air Ministry was essential to the survival of the industry.[268]

To this end, the Air Ministry's position focused more on the skill and doctrine aspect of the mission than the technology transfer. If the Japanese developed naval aviation skills, a new market for British aircraft would be created that would not have otherwise existed. No doubt, it was not lost on the Air Ministry that the mission would bring more than 100 aircraft with it to Japan – aircraft that would be built (mostly) in British factories – some were assembled in Japan.[269] The training would increase British prestige, so the Air Ministry thought, in the eyes of the Japanese and increase the likelihood they would buy specifically British aircraft even if the Japanese were not guaranteeing any aircraft purchases now – other than what the mission would need to complete its training.

It is conceivable that the Air Ministry viewed the provision of shipboard naval aviation technology (i.e. helping the Japanese build aircraft carriers, an area in which they had specifically asked for assistance) as providing a technology that would also create a market for British aircraft.[270] Once the Japanese had aircraft carriers, they would need aircraft to fill their decks. But no records exist of the Air Ministry taking this position, nor did they try to keep aviation specific technology from reaching the Japanese. Trenchard also mentioned that if the

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[266] David Edgerton, *England and the Aeroplane: Militarism, Modernity and Machines*, New edition (London: Penguin Books, 2012), 49.
[267] Reese, *Transforming the Skies: Pilots, Planes and Politics in British Aviation, 1919-1940*, 3.
[268] Edgerton, *England and the Aeroplane: Militarism, Modernity and Machines*, 45.
[269] James, *Gloster Aircraft since 1917*, 76.
[270] Confidential Memorandum from the Japanese Naval Attaché in London, No Date, TNA: FO 371/5358, F2337/193/23, p. 10.

mission went to Japan the British, would have access to the latest and most detailed information on Japanese aviation progress, but it was more of an additional point than an independent reason.[271]

2. How did the Air Ministry assess Britain's future interest alignment with Japan?

Less documentation exists as to the Air Ministry's view of the future relationship with Japan than for the other ministries. Given the evidence that does survive, however, at best the Air Ministry thought the future attitude of Japan was ambiguous; more likely, it also viewed Japan as a potential future threat. Unlike the Admiralty and the War Office, the Air Ministry does not appear to have been consulted during the early 1920 assessment of the Anglo-Japanese Alliance. Nonetheless, it seems unlikely the Air Ministry would have held an assessment of Japan in 1920 that was radically different than that shared by all the other ministries involved in the relationship. Similarly, during the interdepartmental discussion of the mission, the Air Ministry made no statements about how it viewed the future of the British relationship with Japan. This lack of specific statement, however, provides some insight. In its advocacy, the Air Ministry never attempted to directly counter the War Office and Admiralty assessments that Japan was a future threat; instead it chose to play down the impact a mission might have on Japanese capabilities in the long run.[272]

More importantly, the Air Ministry also saw Japan as a threat. The Royal Air Force made its decisions about what forces to allocate to the defense of Hong Kong on the assumption that it would be defending against the Japanese.[273] Similarly, the Japanese came first to mind as a

[271] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 41.
[272] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 41.
[273] Ferris, "A British 'Unofficial' Aviation Mission and Japanese Naval Developments, 1919–1929," 422.

potential threat for senior Air Ministry officials at a November 1920 conference to set policy on the use of aircraft carriers versus seaplanes. After an introduction by the Admiralty that discussed how the meeting had been triggered by the Atlantic Fleet commander's request for the Royal Navy to build aircraft carriers, Air Vice Marshall A. Vyell Vyvyan stated the first question that needed to be resolved was where the Navy would be most likely to fight. Vyvyan then broke with the Admiralty's discussion of the Atlantic. He thought fighting would most likely occur "in the neighborhood of Australia."[274] The only major power the British would be likely to fight near Australia was Japan. While little explicit evidence exists, it seems likely that the Air Ministry also viewed Japan as a future threat.

Additionally, though the Air Ministry was already on its way to developing its strategic bombing doctrine, it also saw an important role for the Royal Air Force in naval operations. Less than six months after the decision to send the Sempill mission, in March 1921, the Air Ministry would need to make the case for its existence to a committee led by Arthur Balfour.[275] Hugh Trenchard argued that aircraft with torpedoes should be substituted for battleships for naval defense. He would make the same argument four years later when he suggested Britain should invest in aircraft rather than coastal artillery for the defense of Singapore.[276] In short, the Air Ministry was already the strongest advocate for the value of airpower in a naval conflict.

3. Did the Air Ministry express concerns about the ability of the recipient state to protect technological secrets?

   No. At no time did the Air Ministry discuss this concern.

[274] "Report of Conference held at the Admiralty on Monday, 29th November 1920 to discuss 'The future development of the most suitable types of machines for Naval Air Work,'" 29 Nov 1920, TNA: AIR 5/209, S14310, p. 3.
[275] Andrew Boyle, *Trenchard* (London: Collins, 1962), 397–98, http://hdl.handle.net/2027/mdp.39015016781323.
[276] Boyle, 551–56.

4. Did the Air Ministry assess the pace of innovation in the technological area under consideration? If they did, did they assess the pace of innovation as unusually quick?

Yes. Unlike all the government ministries involved in the discussions to send the Sempill mission to Japan, the Air Ministry leaders had technical expertise in aircraft. Using that expertise, they assessed that aviation had a rapid pace of innovation in 1920. This pace of innovation led them to believe that any technological information the mission provided to the Japanese would soon be outdated, increasing their willingness to provide cutting-edge technology.

The Air Ministry assessed aviation as evolving rapidly. During the First World War aviation technology had advanced with incredible speed. Tony Pilmer argued that aircraft advanced two generations during the war.[277] Modern computer analysis of First World War aircraft confirms technological advances that drove shifts in equipment superiority every six to nine months.[278] In 1918, the Times of London's aviation expert expected speedy innovation to continue declaring that "evolution in aerial navigation will probably be fifty to one hundred times as rapid as was the evolution of maritime navigation."[279] He predicted engines could reach 1,000 or 1,500 horsepower in a year, when the most advanced engines could only generate 400 horsepower.[280] One reason that officials may have expected rapid innovation to continue despite

[277] Tony Pilmer, "'Gentlemen and Players?'* How the Aeronautical Society of Great Britain Adapted When the Aeroplane Went from Theory to Practice, 1896-1927," *Journal of Aeronautical History*, January 2021, 272.
[278] Scott Eberhardt, "Technology Innovations in World War I Airplane Design," *SAE International Journal of Aerospace* 8, no. 2 (December 2015): 282–91, https://doi.org/10.4271/2015-01- 2581.
[279] Times of London, *The British Aircraft Industry, Its Industrial and Commercial Potentialities*. (London, New York etc.: Pub. for the Times by Hodder and Stoughton, 1918), 297, https://catalog.hathitrust.org/Record/006499383.
[280] Times of London, 299; J G Vincent, "THE LIBERTY AIRCRAFT ENGINE," *SAE Transactions* 14 (1919): 385–432.

the emerging trouble in the aviation industry was that may British armaments firms had used their war profits to establish research laboratories in 1919.[281]

As previously noted, a key protagonist in the story of the Sempill mission was Major-General Frederick Sykes, who was the Controller-General of Civil Aviation at the Air Ministry in 1920. He pushed support for the mission and introduced the Japanese Naval attaché Captain Kobayashi to Sempill. In 1922, he published his treatise on the role of aviation in war and the importance of civil aviation in supporting it. While his book reflected his opinions, it had no direct connection to the Sempill Mission, which it never mentioned. While he was likely writing the book around or just after the time the decision about the mission occurred, it was published more than a year after the mission left, so it could not have been written to affect deliberations on the subject. In it he claimed, "Knowledge of aeronautics is still slender and improvements are made so continuously that machines may become obsolete within a few months."[282] This assessment matched that of others in the Air Ministry. Brackley wrote to Sempill that in his meetings in mid-1922 in England with Air Vice-Marshall Salmond (the Head of Supply and Research) and General Bagnold Wild, they had told him that their goal was "to keep only one year ahead of other nations with regard to design."[283] Later historians agreed with this assessment. Ferris noted that at the time of the Sempill Mission two-year-old information was worthless.[284] Clearly, the Air Ministry's leadership viewed aviation technology as evolving rapidly and thought that a margin as small as a year was sufficient for Britain to maintain its edge.

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[281] Michael Sanderson, "Research and the Firm in British Industry, 1919-39," *Science Studies* 2, no. 2 (April 1, 1972): 1115, https://doi.org/10.1177/030631277200200201.
[282] Frederick Hugh Sykes, *Aviation in Peace and War* (London: Edward Arnold & Company, 1922), 108, http://www.gutenberg.org/ebooks/25244.
[283] Brackley, *Brackles*, 169.
[284] Ferris, "A British 'Unofficial' Aviation Mission and Japanese Naval Developments, 1919–1929," 420.

Indeed, these views help us better understand the arguments the Air Ministry representatives made during the interdepartmental conference. Air-Commodore Steel asserted that while it was true that aviation affected all naval questions, "very little harm would result if no future developments were given to the mission."[285] Similarly, when Lord Beatty argued that a mission could not help but share all the information its members possessed with the Japanese, Trenchard agreed but countered that the mission could be kept ignorant of any developments that occurred after they departed.[286] He also pointed out that the proposed mission would only last two years.[287] These comments make sense in the context of the Air Ministry's argument. In an area of technology that was advancing as rapidly as the Air Ministry thought aviation was, the months it would take for the members to travel to Japan would mean the Japanese would be behind from the start. By the time the mission had completed its early basic training and reached more advanced subjects, their information would likely be a year or more old. This threshold met the margin of innovation advantage the Air Ministry desired.

In summary, the Air Ministry faced a threat to its continued ability to perform its mission that the mission could help resolve. It also likely viewed Japan as a potential future threat, but it assessed the danger from the technological information the mission might provide to Japan as low because it viewed aviation as having a rapid pace of innovation. This pace of innovation shortened the time horizon on which the Air Ministry viewed the issue. Given these positions, my theory predicts that the Air Ministry should have supported a minimal technology sharing policy.

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285 "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 42.
286 "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 41.
287 "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 42.

As predicted, the Air Ministry supported sending the mission to Japan. From the beginning the Air Ministry was favorable towards the proposed mission.[288] What type of policy did the Air Ministry support? The Air Ministry supported a minimal technology sharing policy. As we have seen, even after the Undersecretary of State for Air approved the recommendation of the Interdepartmental Conference to deny the Japanese an official naval mission but allow a civil aviation mission, the Air Ministry worked assiduously to ensure that a civilian mission able to teach naval skills was organized. One of General Sykes' closest aides even personally telephoned the Foreign Ministry to ensure a suitable reference to a civil mission was in the official response.[289]

More specifically, the Air Ministry preferred a minimal technology transfer policy because it advocated for a one-off transfer of cutting-edge technology (though it believed that technology would quickly become obsolete). Trenchard essentially described this combination when he said, "It was quite true that the mission would not be able to avoid telling the Japanese all that they knew, but there was no necessity to keep the mission informed of developments which took place after they had left."[290] Here, he admitted that the mission would end up providing the Japanese any information they had, which would undoubtedly encompass state-of-the-art information at the time they departed. On the other hand, he envisioned that the mission would not receive any further updates. He further noted that the proposed mission would have a definite duration – it would only last two years.[291] Taken together these latter two points make

[288] Letter from Charles Evans to Mr. O'Malley, 16 Oct 1920, TNA: FO 371/5358, F2460/193/23, p. 25.
[289] Minute by Miles Lampson, 20 Jul 1921, TNA: FO 371/6693, F2577/421/23, p. 206.
[290] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 41.
[291] "Report of Meeting Held Noon Friday, 15 October, in the Board Room, Admiralty, To Consider the Request of the Japanese for a British Naval Air Mission," 15 Oct 1920, TNA: FO 371/5358, F2561/193/23, p. 42.

clear that Trenchard envisioned a one-time transfer of information, even if it took some time to complete that transfer.

The Air Ministry Retreats

Aside from the Admiralty's already discussed reengagement with the Sempill Mission in the latter part of 1922, most of the ministries involved had little more to say on the mission or the transfer of naval aviation technology to Japan. Indeed, there would have been little reason for further comment to occur as for most ministries the subject did not come up nor did the underlying conditions significantly change. The one exception was the Air Ministry. The Air Ministry continued to interact with both the remainder of the mission in Japan and with Sempill. Indeed, it went from supporting Sempill's activities to being involved in a counterintelligence investigation against him. During that investigation, the activities for which the Air Ministry criticized Sempill were exactly the sort of activities it had promoted during his mission to Japan. What happened to change the Air Ministry's perspective? By 1923 and 1924, the pace of aviation innovation had begun to slow. As my theory would expect, this led to greater concern with secrecy across the Air Ministry.

1. What motivations, if any, did the Air Ministry have to share technology with Japan?

The Air Ministry continued to have the same incentives to support the mission as before in hopes of gaining sales for the British aviation industry. First, the Sempill Mission seemed to help. The Sempill Mission brought 113 aircraft to Japan in 1920 and 1921. Total British aircraft exports to foreign countries in those years were 427 and 466, so the mission's aircraft alone had been about 12% of the two years' sales.[292] Sempill thought his mission was responsible for

[292] Peter Fearon, "The Formative Years of the British Aircraft Industry, 1913-1924," *The Business History Review* 43, no. 4 (1969): 482, https://doi.org/10.2307/3112038.

selling a million pounds worth of aircraft and had "contributed materially to keep the British aircraft industry on its legs during the period of post-war depression."[293] Historian John Ferris put the value of sales between 325 and 550 thousand pounds, but still thought the sales helped Vickers, Supermarine, and A.V. Roe Stay afloat. He noted that Japan remained one of Britain's best aviation export markets until 1931.[294]

Second, the crisis in both the British aviation industry and the challenges to the continued existence of the RAF and Air Ministry continued. Aviation consolidation continued until 1928. One firm re-entered in 1924 only to exit again in 1929.[295] Not until 1926, would Prime Minister Stanley Baldwin declare British security to be based on "three co-equal services," cementing the permanence of the RAF.[296] The British government continued to highly rate Japan's potential as an overseas market for British aviation firms. After an embarrassing incident in late 1924 when a British pilot failed in an attempt to fly around the world after leaving Japan, the Department of Overseas Trade wrote to the Air Ministry, "there is no necessity to enlarge upon the commercial significance of Japan and Siam as potential markets for United Kingdom manufacturers of aeroplanes and other aviation material."[297] The Department of Overseas Trade proposed working with the Air Ministry to repair Britain's aerial reputation.

This episode suggests it is unlikely the Air Ministry had given up on selling aircraft to Japan.

2. How did the Air Ministry assess Britain's future interest alignment with Japan?

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[293] Letter from C. Eliot to Wm Tyrrell, 21 July 1922, TNA: FO 371/8050, F2204/1065/23, p. 19a.
[294] Ferris, "Armaments and Allies," 262.
[295] Edgerton, *England and the Aeroplane: Militarism, Modernity and Machines*, 50.
[296] Quoted in Overy, *The Birth of the RAF, 1918*, 104.
[297] Letter from the Department of Overseas Trade to the Secretary of the Air Ministry, 12 Nov 1924, TNA: AIR 5/388, Document 88A.

The Air Ministry continued to evaluate the Japanese as a potential future threat. In general, the British continued to see Japan as its most likely adversary in the Far East after the end of the Anglo-Japanese Alliance. But additional evidence suggests the Air Ministry continued to hold this perspective even as the Washington Conference may have temporarily reduced the risk of war.

First, when Flight Officer R. Vaughn-Fowler returned to Britain from Japan in 1922, he produced a short book manuscript and a report on the state of Japan and Japanese aviation as well as report with recommendations for creating a British commercial air route in the Far East as a method of creating an RAF reserve and hampering Japanese aviation development.[298] In these writings, he stridently argued that Japan would pose a future threat. He thought Japan's increasing population, import dependence, and decreasing exports would necessarily lead to an expansionist policy.[299] He suggested that while he thought there was "very little chance of war in the 'Far East'" just then, Japan was building her armed forces in a way that could only be meant for expansion.[300] He thought that by 1927 these forces would rival any in the world.[301] He specifically argued that Japan recognized that Britain was the "one stumbling block" to Japan's expansion.[302]

[298] For manuscript, see R. Vaughan-Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358; For report on state of Japan and Japanese aviation see, R. Vaughan-Fowler, "The Far East Problem," 1 Apr 1924, TNA: AIR 5/358; For commercial air and RAF reserve recommendations, see R. Vaughan-Fowler, "The Far East," 1 Apr 1924, TNA: AIR 5/358.

[299] R. Vaughan-Fowler, "The Far East Problem," 1 Apr 1924, TNA: AIR 5/358, p. 4

[300] R. Vaughan-Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358, p. 106.

[301] R. Vaughan-Fowler, "The Far East Problem," 1 Apr 1924, TNA: AIR 5/358, p. 4.

[302] R. Vaughan-Fowler, "The Far East Problem," 1 Apr 1924, TNA: AIR 5/358, p. 4. Today, this assessment seems chauvinistic. In retrospect, the United States was a more significant obstacle to Japanese expansion that the British Empire. In the interwar period, however, the Japanese armed forces saw Britain as the greatest obstacle to their expansion in China. One example was Lieutenant Commander Otta Ishimaru's book *Japan must Fight Britain* published in Britain in 1936. Towle, *From Ally to Enemy*. p. vii.

In the Spring of 1924, while stationed at the RAF Base in Leuchars, Scotland, he submitted his book and these reports to his commander, who forwarded them to the Air Ministry. The file indicates these papers were circulated at the Ministry and were thought of well enough to be forwarded to the Deputy Chief of the Air Staff and the Undersecretary of State for Air. The latter thought them sufficiently worthwhile to send them to the Chief of the Air Staff and the Secretary of State.[303] The file contains marginal notes, and at no point did any of these officials make notes that expressed skepticism about Vaughn-Fowler's position. Moreover, Air Ministry leaders themselves expressed similar concerns about Japan. In late 1924, the Deputy Air Chief of Staff wrote to the RAF Coastal Area Commander about the importance of flying boat development. He assessed that while war seemed "remote" the "most likely" scenario for flying boat use "would be in a war in the Far East" – a somewhat unusual comment for a letter addressed to an officer charged with defending the British Isles.[304] In any event, again, concern over war in the Far East meant concern about a Japanese threat. In 1924, the Air Ministry continued to view Japan as a potential future threat.

3. Did the Air Ministry express concerns about the ability of the recipient state to protect technological secrets?

   No. At no time did the Air Ministry discuss this concern.

4. Did the Air Ministry assess the pace of innovation in the technological area under consideration? If they did, did they assess the pace of innovation as unusually quick?

[303] Minutes, TNA: AIR 5/538.
[304] Letter from the Deputy Chief of the Air Staff to the Air Officer Commanding Coastal Area, 15 Sep 1924, TNA: AIR 5/209, S14310, Document 46A.

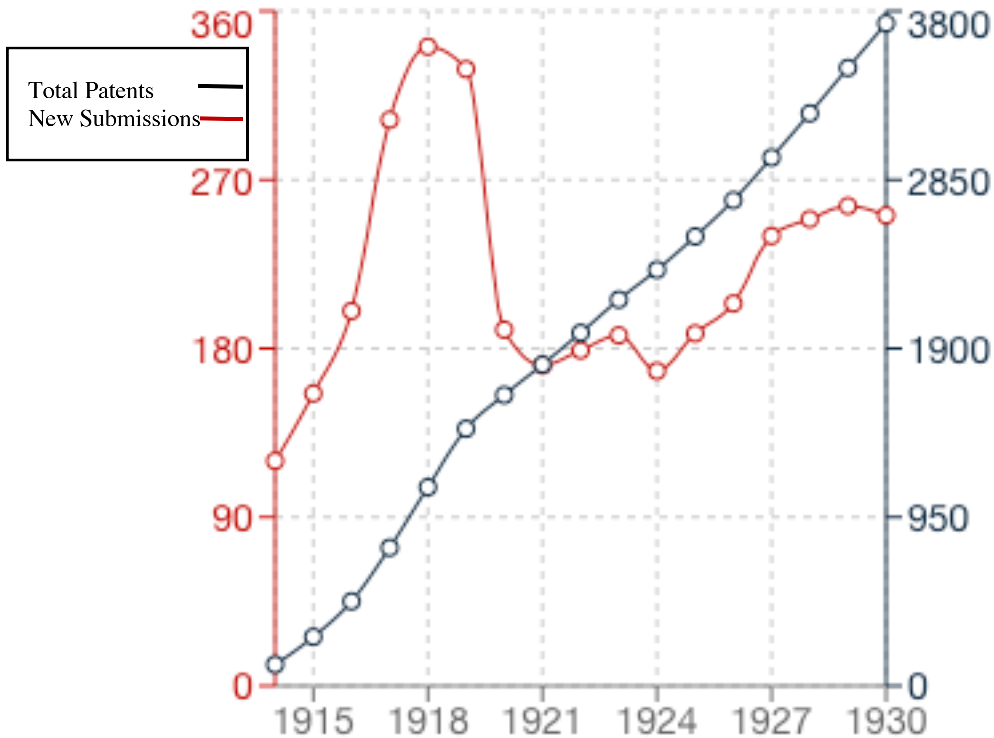
When deciding to support the Sempill Mission in 1920 the Air Ministry had seen aviation as having a fast pace of innovation, but by 1923 the Air Ministry came to believe the pace of innovation had slowed. This change made itself evident in tighter security for new aviation technological developments across the Air Ministry's work.

Slowing innovation likely occurred for several reasons. The competitive pressure of the war has subsided. Decreasing resources mattered too. As firms had less money and less demand, they had less capacity to innovate. Government resources for research and development declined too. The budget for the Royal Aircraft Establishment at Farnborough, a center for British aviation research and development, fell after the war. In 1919, it employed more than 5,000 workers, many of whom helped build aircraft. By the end of 1920, its workforce had fallen more than 73%. As historian Graham Rood put it, "over the next few years research and development continued but at a considerably reduced level."[305] By 1924, the effects were clear when a popular aviation magazine claimed the fastest British two seat fighter was only as fast as the fastest French flying school trainer.[306]

[305] Graham Rood, "The Royal Aircraft Establishment Farnborough," *Journal of Aeronautical History*, May 7, 2020, 58.
[306] Fearon, "The Formative Years of the British Aircraft Industry, 1913-1924," 487.

By 1923 and 1924 it became obvious that the pace of aviation innovation had slowed.

Figure 3-1: Aviation and Naval Aviation Patents Published in Great Britain by Year of Filing



Measuring the pace of innovation is difficult. While no method is perfect, one proxy for the pace of innovation over time is the yearly number of patents filed in each area. As Figure 3-1 shows, filings for aviation and naval aviation related patents that would be published in Great Britain skyrocketed over the course of the First World War and stayed high through 1919.[307] In 1920, they fell by almost half and stayed at this level for several years. As previously shown, when the Air Ministry was making its initial decision to support the Sempill Mission in mid-to-late 1920 the rapid pace of innovation of the previous years still dominated their thinking. Even if they had

[307] European Patent Office, Espacenet Patent Search, Search Terms: (CPC OR IPC B64 (Aviation) OR B63G11/00 OR B63B35/00) AND Countries (Publication) = GB AND Family Priority Date = 1914 to 1930, https://worldwide.espacenet.com/patent/search?f=oprid%3Ain%3D19140101-19301231%7Cpublications.cc%3Ain%3Dgb&q=cl%20all%20%22B63G11%2F00%22%20OR%20cl%20all%20%22B63B35%2F00%22%20OR%20cl%20all%20%22B64F1%2F00%22%20OR%20cl%20all%20%22B64%22&queryLang=en, accessed 15 May 2020.

begun to perceive the drop in patent applications, they might have believed it was only an aberration. By 1923/24, however, it was clear the trend of a reduced pace of innovation was the new normal.

More importantly, however, Air Ministry officials themselves perceived that they needed a larger margin of superiority to stay ahead of competitors. Whereas in 1922 some Air Ministry Officials seemed to think they needed to stay only a year ahead of competitors, by 1923 the Air Ministry wanted to be able to stay two to three years ahead.[308] Similarly, planning for new seaplane designs was beginning to take place over a longer time horizon. In the spring of 1924, RAF Coastal Area Headquarters expected that flying boats which were then being considered for design would not enter production until at least 1927. It planned for them to be in service for six to ten years – though the letter did make clear that aircraft would need enough reserve buoyancy to allow for mid-life engine upgrades as this had continuously occurred with previous aircraft.[309] Regardless, aircraft were no longer obsolete after mere months as General Sykes had claimed.

Indeed, beyond the Japanese case, the Air Ministry began to pay much closer attention to the secrecy of aircraft in general. Beginning in early 1923 the Air Ministry undertook to increase greatly its effort to protect its secret information from publication in the British press.[310] It would take some time for the effort to come to fruition. But by January 1924 it organized a circular that was sent to British publishers as to what information they could and could not publish.[311] In

[308] "Extract from Minute of Meeting of Admy, W.O. AM + Pres Committee," 9 Feb 1923, TNA: AIR 2/234, S22012, immediately after Document 17A.
[309] Letter from Headquarters, Coastal Area, Royal Air Force to the Secretary of State for Air, 28 Apr 1924, TNA: AIR 209, S14310, Document 45A.
[310] TNA: AIR 2/234, S22012 holds the records for this subject. Its earliest document is from January 1923. A separate file briefly deals with a similar issue in 1921, but it contains the records of only one low level meeting. The solution at this meeting was for the government to provide photographs of aircraft to the press as soon as they completed experimental trials. "Question of Publication in the Press of Details of New Aircraft," opened 6 Jul 1921, TNA: AIR 2/234, 181822/21.
[311] Letter from Walter Nicholson to H.C. Robbins, 26 Jan 1924, TNA: AIR 2/234, S22012, Document 67A.

conjunction with this effort it developed various secret classifications for aircraft and aircraft research and development work.[312] As part of this program, it began to develop and regularly distribute lists of secret aircraft and engines which both the press and manufacturers would be expected to protect from accidental release.[313] The Air Ministry specifically justified these efforts so it could "maintain its lead" over foreign powers.[314] Thus, by 1923, it was clear that the Air Ministry was perceiving a slower pace of innovation and increasing the level of secrecy it used to protect its information accordingly.

Altogether, the Air Ministry still had an interest in supporting the British aviation industry and still viewed Japan as a potential threat. Since the Sempill Mission was initially authorized, the pace of innovation had slowed. Given these values, TOTT predicts that the Air Ministry should no longer have supported sharing technology with the Japanese. Indeed, this change occurred.

As we have previously seen, while the Air Ministry had officially ordered that the mission was to receive no additional help, senior Air Ministry officials had continued to unofficially supply it with information through the summer of 1922. In 1923, the Air Ministry began to tighten things down. In February 1923, after Sempill had returned to Britain, he wrote to Brackley in Japan that even though he had previously been successful in dancing around the Air Ministry's official policy, now information for foreign countries was "considerably curtailed."[315] Six months later, he wrote again. This time the Air Ministry stopped Sempill from

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[312] "Air Council and New Types of Military Aircraft and Engines," 12 Oct 1923, TNA: AIR 2/234, S22012, Document 39A.
[313] "New Types of Military (Including Naval) Aircraft and Engines," No Date, TNA: AIR 2/234, S22012, Document 40A; Letter from J.A. Webster, 30 January 1924, TNA: AIR 2/234, S.22012/1922/Press Section, Document 69C.
[314] "New Types of Military (Including Naval) Aircraft and Engines," No Date, TNA: AIR 2/234, S22012, Document 40A.
[315] Brackley, *Brackles*, 170.

sending a report of information he had already compiled.[316] In 1926, the Deputy Chief of the Air Staff would say directly to Sempill – who had continued to provide information to the Japanese after his return in the same way he had before – "We are particularly jealous about our secrets."[317] When Sempill asked if there were any circumstances in which he might again be given "a similar recommendation as was given in connection with the Japanese Government," he was told "Definitely no."[318] The Air Ministry no longer wanted to share technical information with the Japanese.

Alternative Explanations

Single-period Structural Realism & Technological Capability

Single-period structural realism expects states should share technology as a form of external balancing. Thus, states should share with other states that face a common threat. When modified to account for technological capability, states should only share technology that the recipient state has the capability to assimilate.

The Japanese clearly had the capability to assimilate the technology that the Sempill Mission provided, but did Britain face any threats in common with Japan that could explain the decision send the Sempill Mission? It is hard to see any such threats in 1920. Germany, Britain's antagonist in the First World War, was still prostrate. Even in the event of an unexpected rise, Japan would have been able to provide little combat aid in Europe – as had been the case in the

[316] Brackley, 171.
[317] "Minutes of a meeting held in D.C.A.S.'s Room at 12.0 Noon 4th. May. 1926," 4 May 1926, TNA: KV 2/871, Document 587A, p.18.
[318] "Minutes of a meeting held in D.C.A.S.'s Room at 12.0 Noon 4th. May. 1926," 4 May 1926, TNA: KV 2/871, Document 587A, p. 18. Admittedly, MI5 had been monitoring Sempill for two years at this point, but the Air Ministry had dismissed their concerns on at least four previous occasions. Minutes 153 and 154, 1 May 1924, TNA: KV 2/871. Minute 187, 12 Jun 1924, TNA: KV 2/871; Minute 247, 13 Aug 1924, TNA: KV 2/871; Minute 314, 8 Nov 1924, TNA: KV 2/871. And Sempill had legitimate grounds for confusion. He had been specifically recruited by the Air Ministry to lead an unofficial mission to provide technical information to the Japanese while being paid by them.

recently ended war. Russia, Britain's traditional antagonist in Asia, and the state against whom the Anglo-Japanese alliance had originally been aimed in 1902, was similarly weak. Torn by ongoing civil war, Russia posed no immediate threat. The only remaining potential mutual adversary was the United States. The British, however, knew they needed to avoid antagonizing the United States because a war would be catastrophic. Additionally, the British believed their interests were in far closer alignment with the United States than with Japan.[319] Moreover, no officials discussed complicating the American's strategic picture as a justification for the mission. Thus, it is difficult to see how a single-period structural realist argument could explain the Sempill Mission.

Economic

The Economic argument contends that states share technology to gain economic benefits such as payments or licensing fees and restrain sharing when they believe they may be creating an economic competitor. This alternative explanation makes two predictions. First, decisionmakers should share technology when they perceive their state or organization will gain economically, such as through licensing fees. Second, decisionmakers will restrain their sharing when they are likely to lose economically – for example if they risk creating an economic competitor.

1. Did the sharing arrangement involve monetary payments to the sharing state?

Yes. While the Japanese did not directly pay the British government for technology, there were some economic payments to British individuals and firms. The Japanese paid the salaries of the 30 members of the mission at rates higher than the RAF paid for their ranks – though it appears none of the mission members were in active RAF service when the mission started.

[319] Memorandum by Mr. C.H. Bentinck on the Effect of the Anglo-Japanese Alliance upon Foreign Relationship," 28 Feb 1920, TNA: FO 371/5358, F199/199/23, p.161.

Additionally, the Japanese government purchased all the aircraft and equipment the mission used for training and left the selection of that equipment to the mission's members. In the end the Japanese purchased between 110 and 125 aircraft from the British.[320] Several of these aircraft were samples, which the mission hoped might generate additional orders. The Japanese also purchased parts for an additional 40 aircraft, which were assembled in Japan.[321] The monetary payment for the aircraft and equipment is unclear, but this was a significant purchase. At one British factory in 1918, it took 1500 skilled workers a year to make 144 aircraft.[322] That said, because of the surplus of aircraft and parts left from the war and the general low number of orders, it appears many of these aircraft may have been produced from existing inventories of parts.[323] Regardless, this mission was clearly a major economic opportunity, even if the payments were not for the technology per se.

2. Did leaders cite economic benefits as an important rationale or haggle over them?

No evidence appears that the British haggled with the Japanese over the equipment the mission might provide. But, as discussed above, representatives of both the Air Ministry and the Foreign Office – the two ministries with responsibilities encompassing support for the aviation industry and trade – cited support for British industry in support of the mission. But problems emerge for the economic explanation. Even though a clear economic rationale existed for the mission, the Foreign Office dropped its support for the proposal once faced with the potential

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320 Different sources report different numbers of aircraft, but all are in this range. Edgerton, *England and the Aeroplane: Militarism, Modernity and Machines*, 53; James, *Gloster Aircraft since 1917*, 76; Ferris, "A British 'Unofficial' Aviation Mission and Japanese Naval Developments, 1919–1929," 424. Fowler, "Japan & Japanese Aviation," Feb 1924, TNA: AIR 5/358 p. 38.
321 James, *Gloster Aircraft since 1917*, 76.
322 John Laffin, *Swifter than Eagles: The Biography of Marshal of the Royal Air Force Sir John Maitland Salmond* (Edinburgh: William Blackwood & Sons LTD, 1964), 116. Britain did produce 26,685 aircraft in 1918, in total, so determining if that factory was of average productivity is difficult. Reese, *Transforming the Skies: Pilots, Planes and Politics in British Aviation, 1919-1940*, 2.
323 James, *Gloster Aircraft since 1917*, 76.

security risks. Similarly for the Air Ministry, both it and the British aviation industry remained in a state of semi-crisis in 1923 and 1924 when the Air Ministry shifted its position on the mission. This position change happened even though the Air Ministry was still hoping to sell aircraft to the Japanese.

In summary, while an economic rationale existed for the mission, the economic incentives for the mission remained constant both across ministries and time, but the positions ministries preferred changed. More importantly, while the Air Ministry would circumvent it, the "official" government decision was to refuse to transfer military technology to Japan despite the potential economic gains of sending the mission. Thus, economic explanations alone appear insufficient to explain the Sempill Mission.

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

Concern over future economic competition did not appear to affect the decision-making around the Sempill Mission.

Organizational

This explanation predicts that technology sharing should be a product of organizational processes. In general, military organizations should oppose technology sharing because it can both increase the uncertainty they may face and violate their SOPs. The possible exception to this prediction is when an armed service must operate in close coordination with another state's armed force. In this case, the armed force may favor sharing to reduce uncertainty in the way the partner armed force operates.

1. What was the role of military organizations in shaping the sharing decision?

The ministries of the British Armed Forces played essential roles in formulating the decision for the Sempill Mission. The Air Ministry, Admiralty, and War Office were all involved. The only civilian ministry deeply involved was the Foreign Office, which deferred its arguments to the service departments.

2. If military organizations were involved in the decision, were those armed forces operating in close quarters with the potential recipient state's armed forces?

No. None of the British armed services were operating as allies in close quarters with Japanese forces during the time of the Sempill Mission. The British Army had recently been coordinating with the Japanese as part of the Allied intervention in the Russian civil war, but by the middle of 1920, the British had withdrawn from the Russian Far East. More importantly, British and Japanese naval and air forces were not operating together.

3. What was the role of scientific organizations in shaping the sharing decision?

Scientific research organizations did not play a role in the Sempill Mission.

Based on these factors, military SOPs could have played a large role in the Sempill Mission decision. In general, we should expect these SOPs to oppose sharing. Indeed, this prediction coincides with the Admiralty's consistent position. Though the War Office changed its position, the position it ultimately adopted also coincides with this prediction. Thus, organizational processes accurately predict the position of both the Admiralty and the War Office.

Assessing how organizational processes ought to predict the position of the Foreign Office is more difficult. The Foreign Office had a more complicated portfolio. It had an interest both in avoiding wars and maintaining favorable relations with other states. It also had an interest, as previously discussed, in promoting British trade. In general, these interests should have inclined the Foreign Office to support the mission. On the other hand, the Foreign Office also had an interest in maintaining British power so it could negotiate more effectively. Thus, while organizational explanations would seem to incline the Foreign Office to support the mission, they do not point in only one direction.

Finally, the Air Ministry. In this case, the expected SOPs of a military organization to protect its proprietary information clash with the Air Ministry's interest in supporting the British aviation industry. Whichever of these positions we expect to dominate however, both would produce constant predictions for the period under consideration. Either the Air Ministry should have consistently opposed or consistently supported the mission, but its position changed.

Overall, organizational explanations do relatively well in predicting the positions adopted by the various ministries of the British Government – indeed TOTT also relies heavily on organizational explanations in explaining peacetime technology sharing – but more generic organizational theory struggles to predict changes in the position of the Air Ministry or predict the final position of the Foreign Office.

Conclusion

The Sempill Mission provides a peculiar case of technology sharing. The British government officially decided that it would not provide its technology to the Japanese. Though some ministries involved in the decision had reasons to support the Sempill Mission, all the involved ministries saw Japan as potential future threat. This concern restrained all but the Air Ministry from supporting the mission. After the First World War, the Air Ministry faced serious threats to its independence and struggled to keep the British aviation industry afloat. It saw the Sempill Mission as a lifeline. Despite recognizing Japan was a likely future threat, the Air Ministry believed aviation technology was advancing rapidly and discounted the risks of sharing technology. As a result, it disregarded the official decision not to train the Japanese in naval aviation and created a civilian mission to provide the training which allowed it and the rest of the

British government to deny involvement. The decision to send the mission attracted attention for its peculiarity in the United States, in Parliament, from at least one other cabinet official, and eventually from the Admiralty. Once it appeared that the pace of innovation was slowing, the Air Ministry changed its tune about providing information to Japan.

Table 3-1 shows the predicted values for technology sharing policy for my theory and the technology sharing predictions for each of the alternative explanations, as well as the observed values from the case. While all theories correctly predict the positions of the Admiralty and the War Office, and organizational and economic theory come close to accurate predictions, only TOTT can explain why the Air Ministry changed its position. TOTT also explains the different positions taken by the Air Ministry and the Foreign Office over supporting the mission despite their stated mutual interest of supporting the sale of British aviation equipment overseas.

Table 3-1: Theory Predictions and Actual Values for Technology Sharing in the Sempill Mission

	TOTT	Structural Realism	Economic	Organizational	Actual Desired	Actual Observed
Foreign Office	None	None	Share	Ambiguous – lean Share	None	Minimal
Admiralty	None	None	None	None	None	
War Office	None	None	None	None	None	
Air Ministry I	Minimal	None	Share	Ambiguous	Minimal	
Air Ministry II	None	None	Share	Ambiguous	None	None

In the end, the Admiralty's concerns proved valid. The Sempill Mission jump-started Japanese naval aviation, taking them from where the Royal Navy had been on the eve of the First World War to close to the state-of-the-art. Twenty years after the mission arrived, the Royal Navy and the Japanese Naval air service would meet again off the coast of the Malay peninsula.

Chapter 4
Anglo-American (Attempts at) Exchange, 1917-1924

Once it became clear that the First World War would not be the short war that all the European powers had anticipated, the Allied governments realized that scientific and technological developments could play an important role in achieving victory. An outgrowth of the effort to harness technology for the war was technological collaboration between states. Once the United States entered the war, the British and Americans routinely traded publications and reports on their research and scientific missions. Despite the benefits this collaboration provided, most of it ended shortly after the end of the war. This was not for lack of trying. The United States and Britain continued to negotiate an agreement to exchange aviation technology on and off until late 1924 – six years after the end of the war – before finally giving up. This chapter explores the technology sharing that took place during and after the war. While the severe and immediate German threat had motivated technology sharing during the war, the lack of such a clear motivation after the war led to radically reduced technology sharing. Even as agencies in both Britain and the United States recognized the benefits that they had gained from the wartime exchange, they were unsuccessful in negotiating a new agreement for ongoing exchange.

These negotiations went through two phases. Within six months of the end of the war both the British and the Americans reduced technology sharing. Thereafter, for about two and a half years during the first "Post-War" phase, neither government considered ongoing exchanges. Instead, both governments considered the exchange of cutting-edge technology or applied research and development as part of one-off exchanges; even then many suggested transfers were denied.

The second phase, the Negotiation, begins in the summer of 1922. The Washington Conference had reduced fears of an arms race between the two states, and the Americans proposed upgrading the relationship between Britain and the United States to include the on-going exchange of some naval aviation research and development. This proposal would have changed the relationship to a specified technology sharing policy. Though never implemented, the significant effort put into this proposal as well as the shift in the desired policies of both the U.S. Government and, eventually, the British Air Ministry merit a separate analysis of this period as an unrealized opportunity for technology sharing.

Fundamentally, this chapter showcases the difficulty of engaging in technology sharing in the absence of an external threat. Organizational and economic arguments often push against sharing, as does the risk that a recipient could become a potential adversary – even when that risk is small. These impulses are reinforced by asymmetric information problems. One side can never know for sure what the other side has to offer unless sharing occurs. Even when the first side offers to provide a sample of its information, the other side cannot be sure the first side has not held something back.

The remainder of the chapter unfolds as follows: First, I briefly confirm that the case at hand meets TOTT's scope conditions. I then analyze each of the three periods described in chronological order: the First World War, Post-War, and the Negotiation. When analyzing the position taken by the government or the ministry during each period, I use the standardized questions from Chapter II to establish the technology sharing policy predicted by TOTT. I also assess the power of the various alternative explanations. I conclude by comparing the predictions of all explanations for each unit analyzed.

Scope Conditions

1. Was the technology sharing that occurred, or was under consideration, government-to-government?

Yes. While additional technology transfer occurred with firms or through private citizens – especially prior to American entry to the First World War – during each of the periods described, technology exchange occurred or was discussed as an official action between the governments of Britain and the United States.

Moreover, despite officials' claims to the contrary, there was always technology or research to share, as the case of the battleship bombing experiments demonstrates. The British believed their experiments on Baden were methodologically superior to the American tests, but the British experiments were, in fact, inferior to what the Americans had done and would do. Most of the testing on Baden involved gunnery. After the gunnery tests, the British placed six aerial bombs in different positions on the deck of the Baden and detonated them. After a brief survey, they concluded the damage would not have put the ship out of action.[324] By contrast, the U.S. Navy conducted multiple rounds of tests. Even before Project B, the U.S. Navy conducted experiments on the former USS Indiana which involved both 'static' bombs placed on the ship as the British had done with Baden to assess potential for damage and the dropping of dummy bombs to assess the accuracy of aircraft.[325] The Project B tests featured multiple vessels from submarine to destroyer to battleship and were scientifically designed to assess what types of weapons caused what types of damage. In each test, aircraft flew over the target ships and dropped bombs. After a few bombs, the attacks would stop, and a naval survey party would

[324] William Schleihauf, "The Baden Trials," *Warship*, 2007, 81–90.
[325] Isaac Don Levine, *Mitchell, Pioneer of Air Power* (New York: Duell, Sloan and Pearce, 1943), 206–8, https://catalog.hathitrust.org/Record/006580368.

board the vessel to make a detailed damage assessment before the experiment continued.[326] Indeed, Mitchell would accuse the U.S. Navy of taking too much time during the assessments as a stalling tactic.[327]

2. Was the technology transfer that occurred or was under consideration deliberate (i.e. the technology transfer was known to be a likely outcome of the activity under consideration)?

Yes. Both the British and American governments intended to transfer technology in the examples provided.

3. Did the technology transfer involve transferring the capability to produce weapons or other items without further support from the sharing state?

Yes. Most commonly, the exchange of technology between Britain and the United States involved the exchange of applied research and development information which would necessarily imply the receiving state would be gaining that information for its own use for production. Indeed, the British desire to reduce technology sharing after the war to protect the British aviation industry highlights that they expected the Americans to use the information gained for their own production capabilities.[328]

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[326] Wesley Hale, "The SMS Ostfriesland: A Warship at the Crossroads of Military Technology" (Masters, University of Rhode Island, 2018), 72, Open Access Master's Theses (Paper 1223), https://digitalcommons.uri.edu/theses/1223. Johnson, Alfred Wilkinson. *The Naval Bombing Experiments Off the Virginia Capes: June and July 1921, Their Technological and Psychological Aspects*. Washington, DC: Naval Historical Foundation, 1959, https://web.archive.org/web/20120815222438/http://www.history.navy.mil/library/online/navybomb1.htm

[327] William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power - Economic and Military* (New York and London: G. P. Putnam's sons, 1925).

[328] Minute 7 to CAS by R.M. Groves (DCAS), 27 June 1919, TNA: AIR 5/489.

Allied Technology Sharing During the First World War

When the First World War began, the European powers universally thought it would be a short war. Not until early 1915, when it became clear that the stalemate on the Western Front was likely to last, did the Allied governments begin to look seriously at supporting technological research and harnessing new technological developments to break through. France created the Direction des Inventions intétressant la défense nationale. In Britain two organizations sprung up, the Board of Invention and Research (BIR) under the auspices of the Admiralty, and the Munitions Inventions Department under the Ministry of Munitions. Initially, these organizations were tasked with reviewing the thousands of unsolicited proposals for new weapons these governments had received, but they soon began coordinating scientific research in support of the war effort as well.[329]

Technological collaboration between France and Britain developed through these organizations. Coordination of scientific exchange began roughly at the same time the British and French governments created a military liaison system and shipping coordination system.[330] In January 1916, the French Ministry of Inventions suggested the Allies begin scientific collaboration. First, the British and French organized a series of expert visits between Paris and

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[329] Zimmerman, *Top Secret Exchange*, 8.

[330] For Military coordination see Kelly Ann Grieco, "War by Coalition: The Effects of Coalition Military Institutionalization on Coalition Battlefield Effectiveness" (Ph.D., Massachusetts, Massachusetts Institute of Technology, 2016), https://www.proquest.com/docview/1838285187/4C058D394EC74DBEPQ/1. For shipping and industrial coordination, see Elizabeth Greenhalgh, *Victory through Coalition: Britain and France during the First World War*, Cambridge Military Histories (Cambridge: Cambridge University Press, 2005), 105–12, https://doi.org/10.1017/CBO9780511497032. More than with scientific exchange, however, shipping and military coordination would increase more substantially over the course of the war. The British and French had coordinated munitions purchases in Britain to prevent price competition from 1914. The French government proposed a united munitions office in 1915, but the military vetoed the proposal. In September 1916, the British and French established an Inter-Ally Bureau of Munitions to extent their coordination of munitions purchases to include purchases in the United States. The Allies would finally establish and Allied Munitions Council in March 1918. The British and French did create a Shipping Control Commission in 1916, much greater coordination began with the Allied Maritime Transport Council in October 1917. These committees coordinated shipping of food and raw materials, but not production of munitions – those decisions remained with each country's government throughout the war. On the military side, in 1918, the Allies would finally adopt a united command structure.

London.[331] In April 1916, the Munitions Inventions Department exchanged a liaison officer with the French.[332] At first the Admiralty resisted the BIR exchanging liaison officers, and provided a multitude of reasons for doing so: the naval attaché could do the liaison work, the BIR liaison might not take sufficient care in handling Royal Navy secrets, and sharing secrets with the French could affect British patent rights.[333] In October 1916, however, the First Lord of the Admiralty overruled these objections, and liaison exchange occurred.[334] These liaison officers facilitated the regular transmission of research reports between the two countries. These reports were augmented by continued exchange of scientific missions as well as the posting of researchers from one country in the other. Franco-British cooperation extended across various areas of research. French submarine detection work was of particular interest to the BIR and helped form the basis for British ASDIC.[335] The British also received French developments in fuse design, aerial cameras, chemicals, explosives, and more.[336]

Even before the United Stated entered the war, the Allies became interested in tapping American scientific research. Witnessing the war and the prominent role of new technology, in June 1916 the American National Academy of Sciences created the National Research Council (NRC) to coordinate war related research. The U.S. Navy created the Naval Consulting Board, which began the first American sonar research in Nahant, Massachusetts, just north of Boston.[337]

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[331] "Report of Proceedings of the Board of Invention and Research to 31st December 1916," January 1917, TNA: ADM 293/7, p. 4.
[332] Zimmerman, *Top Secret Exchange*, 8.
[333] Willem Hackmann, *Seek & Strike: Sonar, Anti-Submarine Warfare and the Royal Navy 1914-1954* (London: H. M. Stationery Office, 1985), 39.
[334] "Report of Proceedings of the Board of Invention and Research to 31st December 1916," January 1917, TNA: ADM 293/7, p. 4.
[335] "Report of Proceedings of the Board of Invention and Research to 31st December 1916," January 1917, TNA: ADM 293/7, p. 10.
[336] Meeting of "The Central Committee, Board of invention and Research," 6 July 1916, p. 3, TNA: ADM 293/7; Meeting of "The Central Committee, Board of invention and Research," 10 Aug 1916, p. 1-2. TNA: ADM 293/7.
[337] Zimmerman, *Top Secret Exchange*, 9.

In July 1916, the Admiralty sent an officer from the BIR to investigate electrical ship propulsion developments in the United States.[338] Just before the United States entered the war, the NRC planned to send a scientific mission to Europe. They would leave in the weeks after Woodrow Wilson asked Congress to declare war.[339]

When the United States did enter the war, the British and French – knowing that the American Mission was already in the works – planned their own reciprocal mission to the United States. Though proposed by the French, the mission became known by the name of the leading British scientist attached to it, Sir Ernest Rutherford, a member of the BIR. The Rutherford Mission is most known for the exchange of research on submarine detection, but it also provided information for ranging artillery guns by sound and coordination of chemical warfare research.[340] When the mission returned, Rutherford recommended the BIR station a liaison officer in the United States, but it appears this never occurred.[341] While his mission reported that the British could not yet learn much from the American anti-submarine measures, the United States had far more scientific resources than Britain or France, and some were already working on the problem. Rutherford's team had provided American scientists some direction and expected they would make rapid advances. Scientific coordination became robust, with frequent requests for information crossing the Atlantic as well as additional missions, even though the allies lacked a formal coordinating office.[342] The Admiralty policy from 1917-on toward France and the United

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[338] Meeting of "The Central Committee, Board of invention and Research," 6 July 1916, p. 1; TNA: ADM 293/7. Meeting of "The Central Committee, Board of invention and Research," 19 Oct 1916, p. 1; TNA: ADM 293/7
[339] Zimmerman, *Top Secret Exchange*, 9.
[340] Zimmerman, 11–12.
[341] Meeting of "The Central Committee, Board of invention and Research," 17 Jul 1911, p. 1; TNA: ADM 293/7.
[342] Hackmann, *Seek & Strike: Sonar, Anti-Submarine Warfare and the Royal Navy 1914-1954*, 43.

States was particularly liberal providing both states access even to technical information "which [could] not be put to use during the war."[343]

Technology transfer extended beyond research cooperation. The Allies transmitted drawings and plans of their weapons systems to the United States so they could take better advantage of American industry.[344] In the second half of 1917, the British sent a naval constructor to assist the U.S. He brought with him the plans for the Royal Navy's aircraft carriers, which assisted the United States in producing its first aircraft carrier designs.[345] When the U.S. entered the war, it had no tanks or tank designs. The U.S licensed production of the Renault FT, called the Six-Ton Tank in the U.S. Army.[346] It would remain the U.S. Army's primary tank into the 1930s. The United States, France, and Britain also negotiated to design and produce a tank together, taking advantage of American automotive knowledge and French and British tank knowledge. Known as the Mk. VIII or "the international," few were produced before the war ended.[347] Similar cooperation occurred in aviation. In late 1917, the U.S. Army sent a special mission to France under the command of Major. R.C. Bolling to gather as much technical information on aircraft as possible to facilitate the construction of aircraft in the United States.[348] As one British official would later put it, "During the war nothing was kept secret between the Allies."[349]

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[343] Quoted in Ferris, "Armaments and Allies." Interestingly, the same policy put the Italians and Japanese in a lesser category of allies who could only receive information "that could be utilized by them during the War to the advantage of the Alliance."
[344] Minute 14 to CAS by D.O.I, 15 Oct 1919, TNA: AIR 5/489.
[345] Hone, Friedman, and Mandeles, *American & British Aircraft Carrier Development, 1919-1941*., 22.
[346] Steven Zaloga, *Armored Thunderbolt: The U.S. Army Sherman in World War II*, First Edition (Mechanicsburg, PA: Stackpole Books, 2008), 2.
[347] George F. Hofmann, "The Demise of the U. S. Tank Corps and Medium Tank Development Program," *Military Affairs* 37, no. 1 (1973): 20, https://doi.org/10.2307/1986566.
[348] John J. Pershing, *My Experiences in the World War*, 1st Ed, vol. 1 (New York: Frederick A. Stokes Company, 1931), 161.
[349] A.R. Boyle, "Notes on the question of the Exchange of Information between U.S.A. and ourselves" for DCAS, 22 May 1924, TNA: AIR 5/489, Document 110A.

By mid-1918, the technical exchange with the United States began to bear fruit in multiple areas. In March 1918, the British Admiralty's Director of Anti-Submarine Detection commented "Submarine detection apparatus is now starting to come over from the US fast. The greater part of it is novel…."[350] He wanted an extra officer to lead the testing of the new equipment. After reviewing aircraft engine progress in Europe, which found the British and French working on 37 and 46 aviation engine designs respectively, the U.S. Army coordinated the development of the first 400 horsepower engine, the Liberty Engine.[351] Unlike the European efforts, the design was mass producible. The United States supplied more than a thousand to the British and French.[352] The United States also designed and produced the Mark VI naval mine, which allowed three mines to cover an area that previously required eight due to its novel antenna. The Mark VI enabled the North Sea Mine Barrage, and the U.S. Navy provided the British the opportunity to closely examine the mine.[353] Had the war continued in to 1919 – as most Allied leaders believed in the summer and fall of 1918 – these contributions would have grown.[354]

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[350] Quoted in Hackmann, *Seek & Strike: Sonar, Anti-Submarine Warfare and the Royal Navy 1914-1954*, 43.
[351] Vincent, "THE LIBERTY AIRCRAFT ENGINE."
[352] Leonard Porter Ayres, *The Official Record of the United States' Part in the Great War* (War Department, 1923), 97, http://hdl.handle.net/2027/uva.x001475593.
[353] Benjamin D. Rhodes, *United States Foreign Policy in the Interwar Period, 1918-1941: The Golden Age of American Diplomatic and Military Complacency* (Westport, Conn.: Praeger, 2001), 19, https://catalog.hathitrust.org/Record/004192653.
[354] Assessing American industrial contributions to the First World War, particularly its munitions contributions before American entry, is difficult, but it is clear the United States provided major support to the Allied war effort. U.S exports skyrocketed during the war. Compared to the four years before the war, U.S. exports increased on average 145% after the start of the war. Food was the largest export category, but the "largest absolute increase" was in "manufactures read for consumption," which would have included arms sent to the British and French as well as other war-related industrial goods. In the beginning munitions were only a small part of this boom, however. From September 1914 to May 1915, shipped $34 million of munitions to the Allies compared to $6 million the year before (numbers that exclude shrapnel), in comparison to $148 of other war supplies like horses, leather goods, aircraft, auto, oil, wire, medical supplies, etc.. , the By November 1916, 40% of British military expenditures occurred in the United States, and by 1917 the Americans supplied half of the British supply of smokeless gun powder and a third of the French supply. When the United States joined the war, initially it could not relay on its own factories to equip its forces. For example, the United States provided raw materials to France, which provided American forces with heavy artillery pieces. As American industry mobilized for war, however, that dynamic began to shift. By the summer of 1918, the U.S. was producing far more than the number of machine guns, rifles, and ammunition to

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1. Did the British support any sharing of military related technology? If yes, what technology sharing policy did the unit support?

Yes, though it took until 1915 for the British and the French to begin sharing technology, once their technological collaboration began, it was open. They frequently exchanged scientific missions and stationed liaison officers at each other's research organizations. Building on this precedent, almost immediately after the United Stated entered the war, the British joined a French mission to coordinate war related research with the United States. Throughout the war the United States and Britain exchanged technology across all aspects of the war including anti-submarine warfare, aviation, chemical warfare, tanks, and naval construction.

TOTT

1. What motivations, if any, did decisionmakers have to share technology?

Once the United States entered the First World War, Britain and the United States shared a severe and immediate threat in the form of Germany.

2. How did sharing state decisionmakers assess future interest alignment with the potential recipient state?

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supply its own forces. The American Browning machine guns were considered so superior to anything in use on either side, that the Allies deliberately delayed their introduction to ensure the Germans could not capture and copy them prior to the Allies being able to use them across the front. U.S. forces were still using French and British artillery ammunition when the war ended, but the volume of production in American factories allowed all the Allied armies to shoot for more rounds that they otherwise could have because they knew the American supply would soon arrive. American factories produced more than 13,000 Liberty Aircraft engines, of which only 5000 reached Europe before the war ended. In short, American industry provided significant war supplies – both weapons and non-weapons – prior to and after the United States entered the war. When the Allies planned the expected 1919 campaign, they did so with the knowledge that vast American material was on its way. Had the war continued, U.S. war production would have quickly reached the "miraculous" scale that it reached in the Second World War. "Exports from the United States Before and After the Outbreak of the War," *Federal Reserve Bulletin*, October 1, 1919; Benjamin O. Fordham, "Revisionism Reconsidered: Exports and American Intervention in World War I," *International Organization* 61, no. 2 (2007): 277–310; Ayres, *The Official Record of the United States' Part in the Great War*, 70–98; Edwin J. Clapp, *Economic Aspects of the War: Neutral Rights, Belligerent Claims and American Commerce in the Years 1914-1915* (New Haven, CT: Yale University Press, 1915), 214–17, https://www.google.com/books/edition/_/sNhFSiCzb1gC?hl=en&gbpv=1.

From early in the twentieth century, Britain had deliberately sought to avoid conflict with the rising United States.[355] In 1909, the British cabinet had decreed that the Admiralty should not include American naval strength when calculating British naval requirements. The British never prepared formal war plans against the United States in the first half of the twentieth century.[356] Based on their 18th and 19th century history, the two countries did not implicitly trust on another, but they no longer had significant clashes of interest. Neither sought to gain the same territory from the war. Some frictions existed. The United States had different views of neutral rights. Before American entry to the First World War, the British wartime blockade had strained relations as it interfered with American commerce – so much so that the British eventually made policy adjustments to lessen its impact on the United States.[357] The British had wanted the United States to enter the war sooner.[358] The British had borrowed significant sums from the United States during the war. This could cause resentment, but also made the British more dependent on the Americans.[359] Wartime cooperation had tended to improve the relations between the two countries' armed services.[360] The United States Navy even integrated a squadron of its dreadnoughts under Royal Navy command as part of the Grand Fleet, an action which necessitated shared signal books. In short, during the war, Britain did not foresee conflict with the United States.

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[355] Kennedy, "The Tradition of Appeasement in British Foreign Policy 1865-1939," 202.
[356] Christopher M. Bell, "Thinking the Unthinkable: British and American Naval Strategies for an Anglo-American War, 1918–1931," *The International History Review* 19, no. 4 (December 1, 1997): 791, https://doi.org/10.1080/07075332.1997.9640804.
[357] Nicholas A. Lambert, *Planning Armageddon: British Economic Warfare and the First World War* (Cambridge, Mass: Harvard University Press, 2012).
[358] Margaret MacMillan, "Isosceles Triangle: Britain, the Dominions and the United States at the Paris Peace Conference of 1919," in *Twentieth-Century Anglo-American Relations*, ed. Jonathan Hollowell, Contemporary History in Context Series (London: Palgrave Macmillan UK, 2001), 9, https://doi.org/10.1057/9780333985311_1.
[359] MacMillan, 10.
[360] Ian Horwood and Christopher Price, "'A Fundamental Weapon': The Transatlantic Air Power Controversy of the 1920s and the US Navy as a Learning Organization," *Journal of Transatlantic Studies*, no. 19 (2021): 7, https://doi.org/10.1057/s42738-020-00061-y.

3. Did the decisionmakers express concerns about the ability of the recipient state to protect technological secrets?

No. I have found little evidence the British had concerns about the American's ability to keep secrets once the United States entered the war, and this lack of concern matches the reality of the situation. First, Germany conducted almost no information collection in the United States during the war. Before 1914, German intelligence had limited resources. It focused what it had on the European powers. As a result, it had essentially no network in the United States. Once the war began, Germany set up covert operations in the United States, but even these relied mostly on embassy personnel and focused on sabotage rather than espionage.[361] These sabotage efforts focused on interrupting the supply of war material and munitions to the Allies. They had several successes. In 1916, German agents blew up Black Tom Island in New York City, which processed seventy-five percent of all munitions shipped to Europe from the United States.[362] Soon thereafter, German agents also destroyed the Kingsland munitions plant. In neither case did the Americans initially suspect sabotage.[363] Britain worked with the United States during this time to combat these, and other, German efforts.[364]

Second, once the United States entered the war, German intelligence activity almost disappeared. Most German agents left the United States three days before the U.S. declaration of war, since in wartime sabotage carried the death penalty.[365] The United States also increased its security measures. The War Department received authority to censor telephone and telegraph

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[361] Markus Pöhlmann, "German Intelligence at War, 1914-1918," *Journal of Intelligence History* 5, no. 2 (December 2005): 37, https://doi.org/10.1080/16161262.2005.10555116.
[362] Jules. Witcover, *Sabotage at Black Tom: Imperial Germany's Secret War in America, 1914-1917* (Chapel Hill, N.C.: Algonquin Books of Chapel Hill, 1989), 23, https://catalog.hathitrust.org/Record/001304893.
[363] Frank J. Rafalko, "A Counterintelligence Reader, Volume I: American Revolution to World War II" (National Counterintelligence Center, 2001), https://fas.org/irp/ops/ci/docs/ci1/index.htm.
[364] Daniel Larsen, "Intelligence in the First World War: The State of the Field," *Intelligence & National Security* 29, no. 2 (April 2014): 290, https://doi.org/10.1080/02684527.2012.727070.
[365] Rafalko, "A Counterintelligence Reader, Volume I." https://fas.org/irp/ops/ci/docs/ci1/ch3time.pdf

lines leaving the country. Mail was censored as well. The U.S. Army's Military Intelligence Service established branches across the United States. The British were aware of these efforts. British and American intelligence agencies worked together to thwart German espionage based in Mexico.[366] In summary, the British had little reason to fear U.S. security during the First World War.

Single-Period Structural Realism & Technological Capability

This alternative explanation expects that current threats and the recipient's ability to absorb technology will be the only factors that determine technology sharing. It predicts that Britain and the United States would extensively share technology once the United States entered the First World War and both states faced the German threat. Because the United States was highly technically capable, Britain should not have withheld any technological information. This explanation generally succeeds in explaining Anglo-American technology sharing behavior during the war.

Economic

The economic alternative explanation holds that states share technology when they gain economic benefits and withhold technology when sharing would damage their economic competitiveness. Unsurprisingly, the economic explanation does not explain why Britain chose to begin sharing technology with the United States once it entered the First World War.

1. Did the sharing arrangement involve monetary payments to a sharing state?

No. No examples of technology sharing for payment appear to have occurred during this period.

2. Did leaders cite economic benefits as an important rationale or haggle over them?

[366] Rafalko. Chapter 3 Counter Intl -https://fas.org/irp/ops/ci/docs/ci1/ch3d.htm#ciww1

No. Leaders do not appear to have discussed economic benefits as a rationale for sharing during this period nor did they haggle over them.

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

No. During this period, concerns over future economic competition do not appear to have impeded technology sharing.

In summary, economic logic does not explain technology sharing during the First World War.

Organizational

The organizational processes alternative explanation predicts that the established SOPs of the ministries involved in making technology sharing decisions should substantially affect technology sharing policy outcomes. Generally, military organizations should resist sharing technology since armed forces usually protect information. This resistance should be particularly pronounced in peacetime. Military ministries should favor more open technology sharing policies with the armed forces of allies with whom they are fighting. Scientific organizations should favor technology sharing.

1. What was the role of military organizations in shaping the sharing decision?

The services played key roles in shaping the decisions about military technology sharing during the First World War. As discussed, the Board of Invention and Research, which sponsored the Rutherford Mission, was part of the Admiralty. While the Munitions Inventions Department was part of the Ministry of Munitions rather than the War Office, many army officers served in the Ministry of Munition's senior ranks.

2. If military organizations were involved in the decision, were those armed forces operating in close quarters with the potential recipient state's armed forces?

During the First World War, American and British forces fought side by side. While technology sharing began well before major American forces arrived in Europe, the British wanted the Americans to arrive as quickly as possible. In this case, providing British technology to the Americans sooner would only facilitate their expected cooperation on the battlefield.

3. What was the role of scientific organizations in shaping the sharing decision?

Independent scientific organizations do not appear to have been involved in technology sharing decisions in this period.

Given these factors, the organizational alternative explanation would hold that military organization SOPs should have influenced technology sharing policy during the war, and the service ministries should have supported technology sharing. These predictions match what occurred.

Table 4-1: Theory Predictions and Actual Values for Technology Sharing in the First World War

	TOTT	Structural Realism	Economic	Organizational	Actual Desired	Actual Observed
First World War	Open	Share	None	Share	Open	Open

Post-War Technology Sharing

The end of the war brought a major shift in the incentives for technology sharing. Post-War, the U.S.-British effort at technology sharing can be divided into two periods as it applied to most information, the first of which can be further subdivided to two phases. The first period began with the end of the war and extended to the summer of 1922. The Spring of 1920 divides the two phases of this first period. In the first phase, exchange slowly tightened from the wartime standard until it was finally replaced by a system of one-off, quid pro quo, exchange. In the second phase, exchange was only on this one-off basis. The second period ran from the summer of 1922 until late 1924 when, at the instigation of the United States, the British and the United States struggled and ultimately failed to negotiate an ongoing exchange of aviation research.

Immediately After the War

Though the war's end did not bring a formal and immediate decision to end open sharing of technology and research that had characterized the period of hostilities, sharing nonetheless began to trail off as the allied nations slowly began to "tighten up the unrestricted exchange of information."[367] Though the war had obviously brought tremendous technological innovation, the British government, and the Air Ministry in particular, seemed only to confront the question of continued technology sharing when presented with a question that forced a decision. Perhaps unsurprisingly given this approach, the Air Ministry's attitude towards technology sharing would vary dramatically over the following months.

The first serious discussion about continuing technology sharing occurred May and June of 1919 after the head of the American Army Air Service Major General Charles Menoher proposed continued exchange of information. Menoher offered "reciprocal" "unreserved exchange of information" with three exceptions: information the Air services did not exclusively control (in which case they would seek to gain release); information "so revolutionary…as to demand … a new policy;" and "information which would disclose trade secrets."[368] In essence, Menoher was suggesting exchange of Air Service controlled research as well as any other research the Air services could acquire, with an escape valve for any incredible breakthroughs.

Officials at the Air Ministry were almost universally opposed. Robert Brooke-Popham the Air Ministry's Director of Research preferred to avoid a general sharing policy. He was concerned the exceptions Menoher proposed were insufficient and was particularly concerned

[367] Minute 6 to DCAS by Lieutenant Colonel W. Signum, 16 June 1919, TNA: AIR 5/489.
[368] Chas. T. Menoher, Memo from Director of Air Service to British Air Attaché, Washington, DC on Exchange of Information, 15 May 1919, TNA: AIR 5/489, Document 1A.

about protecting information, such as the development of metal aircraft, that could give the British aircraft industry an advantage.[369] Air Vice Marshall Edward Ellington, the Director-General of Supply and Research and Brooke-Popham's superior agreed.[370] So did other analysts. The representative of Air Intelligence also noted the Allies' aviation industries were in competition and only national security issues should override protecting their interests. As a result, he suggested that research should be secret until British firms could patent innovations and bring them to market and that any "radically new departure affecting aircraft as a war weapon" should be secret as well.[371] The only information which should be shared freely, he suggested, was that which would improve British prestige or further civilian aviation, like weather and medical research. He thought training methods and civil aviation policy should be exchanged for like information.[372]

The final policy recommendations, which were to be applied to all requests for information, reflected these views. Information on weather, medical research, air route development, and the organization of the Air Ministry would be provided freely. Information on civil aviation policy, the organization of the RAF, and the types of aircraft in use would be exchanged. Information on experimental types, major innovations that could affect aircraft as weapons, and research that British manufactures had not yet used would be withheld. The Deputy Chief of the Air Staff noted that Britain had less to gain than any partner in a reciprocal exchange of information, and that this situation was particularly true in the case of the United States.[373] Thus, just over six months from the armistice and before the Treaty of Versailles was

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[369] Minute 4 to DGSR by DOR Robert Brook-Popham, 10 June 1919, TNA: AIR 5/489.
[370] Minute 5 to CAS DGSR, 12 June 1919, TNA: AIR 5/489.
[371] Minute 6 to DCAS by Lieutenant Colonel W. Wynn, 16 June 1919, TNA: AIR 5/489.
[372] Minute 6 to DCAS by Lieutenant Colonel W. Wynn, 16 June 1919, TNA: AIR 5/489.
[373] Minute 7 to CAS by R.M. Groves (DCAS), 27 June 1919, TNA: AIR 5/489.

signed, the Air Ministry was ready to formally reject continuing exchange of any technological information of military or commercial value until Britain had secured a lead. What information exchange might take place would have been on a reciprocal and one-off basis. Given these policies, this would have been, at best, a minimal technology sharing a policy – a radical change from the open technology sharing policy of the war.

As it happened, however, these policy recommendations remained just that, recommendations. Upon receiving these recommendations in early July 1919, Hugh Trenchard, the Chief of the Air Staff, refused to act. He believed the issue of technology sharing needed to be coordinated with the War Office and the Admiralty first. Indeed, a committee had already been formed to address the issues of "giving technical information to Foreign Powers."[374] Relatively open exchange of information would continue a little longer.

Like the discussion within the Air Ministry, the committee to which Trenchard referred had arisen from a specific concern – a British manufacturer wanted to sell tanks to foreign militaries based on government designs from the war and was preparing to build his factory overseas if needed. The War Office wanted a mechanism to control the delivery of technical information to other states, especially considering the rapid rate at which tank design was improving.

The conference highlighted how differently all the ministries in attendance viewed weapons sales from technology transfer. The Admiralty declared that it never sought to stop British firms from selling weapons to other states, but that it would be opposed to efforts to manufacture abroad – indeed one reason it would not stand in the way of selling abroad was to reduce the risk firms would seek to manufacture overseas. While the War Office acknowledged

[374] Minute 8 from C.A.S to D.C.A.S., 2 July 1919, TNA: AIR 5/489.

that reverse engineering an item which had been sold was an issue, it noted reverse engineering still took time and that it was more concerned with protecting "the exact results of research work."[375] The conference, whose work would eventually lead to revisions to the Official Secrets Act, concluded it should be illegal for British manufacturers to share technical information on weapons on war with foreigners without government permission.[376] While the conference highlighted that each of the services saw a difference between arms sales and technology transfer and in general supported the first but not the latter, it did not resolve the issue of technology sharing policy.

The Air Ministry suggested expanding the charter of the committee, and when that failed, sought to convene a separate conference to discuss the issue.[377] By the middle of October, the Air Ministry Director of Intelligence reported that he thought little would be gained from a committee. Instead, he recommended, "[the Air Ministry] act as they are already doing."[378] The proposal that followed appeared radically different from the discussion a few months before. The Air Ministry should seek to share as much information that was not "really secret" as possible. He argued that little information could or needed to be kept secret after aircraft enter production. Moreover, providing more information would support British industry, make it easier to follow what other countries were doing – especially if they adopted British methods – and make it easier to keep what needed to be secret secret. All that said, it was difficult to determine exactly what Air Intelligence thought needed to be secret, as the proposal still suggested that "detailed

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375 "Conference on 'Sale of War Material' (W.O. No: -57/Tanks/88)," 29 July 1919, TNA: AIR 5/489, Document 9A.
376 "Conference on 'Sale of War Material' (W.O. No: -57/Tanks/88)," 29 July 1919, TNA: AIR 5/489, Document 9A.
377 Minute 11 to CAS by DGSR, 5 Sep 1919, TNA: Air 5/489; Minute 12 by CAS to DOI, 5 Sep 1919, TNA: Air 5/489.
378 Minute 14 to CAS by D.O.I, 15 Oct 1919, TNA: AIR 5/489.

drawings" should be withheld.[379] Perhaps this caveat along with the implicit statement that experimental aircraft should be kept secret meant this policy was not as different as it seemed.

Regardless, Trenchard concurred. For the moment, he endorsed the recommendation with the caveat that each individual request for information needed to be evaluated on its own merits.[380] The shift surprised Ellington, who doubted the wisdom of such a course of action and could hardly believe the Director of Intelligence's claim that the Admiralty and War Office followed a "more is better policy" when it came to sharing.[381]

He proved correct. A month letter Trenchard backtracked after learning the Admiralty's actual policy. Instead, he declared a policy that matched the Admiralty's and that would remain surprisingly constant in execution the next several years. Under this policy, documents classified Secret would be withheld. Those classified Confidential would be provided on a case-by-case basis. His only condition was that the list of Secret documents would need to be updated frequently, such as when aircraft moved into production.[382] A meeting of the Air Council further refined this position. Secret information would only be provided to foreign governments "when absolutely essential to the conduct of joint operations." Confidential information would be provided on a case-by-case basis, usually subject to a quid pro quo with some countries (such as France) receiving preferential treatment.[383] Brooke-Popham, the Director of Research, assumed the responsibility to decide what technical information could be released for what quid pro quo. He prioritized protecting research and experimental work until implemented and supported the

[379] Minute 14 to CAS by D.O.I, 15 Oct 1919, TNA: AIR 5/489.
[380] Minute 15 to DGSR by CAS, 16 Oct 1919, TNA: AIR 5/489.
[381] Minute 16 to CAS though CGCG by DGSR, 17 Oct 1919, TNA: AIR 5/489.
[382] Minute 17 to DGSR by CAS, 12 Nov 1919, TNA: AIR 5/489.
[383] Letter A.13705/S.6. from Air Ministry to Admiralty, November 1919, TNA: AIR 5/489, Document 18A

free exchange of anything having to do with navigation or weather, matters which would advance civil aviation.[384]

The Americans had similar inclinations. Less than two weeks after the Air Ministry and Admiralty coordinated this more restrictive policy, on December 17th, 1919, the Foreign Office received an urgent message from Washington. The British Ambassador, Sir Edward Grey – the former Foreign Secretary who had been dispatched to Washington to help secure approval for the Treaty of Versailles – reported that the American Director of Naval Intelligence had informed the British Naval and Air Attachés that the United States would revert its information exchange policy to the pre-war policy of quid pro quo. As a pretext the American cited the British refusal of an American officer's request to visit the radio room on the battleship HMS Renown, though the Director stated this was nonetheless a deliberate change of policy.[385]

For Grey, the problem was tactical. He wanted instructions on how to proceed and suggested that whatever course the British Government decided upon it be consistent across all the services. He also noted that a decision would need to be made about an Air Ministry representative who was in the United States to teach rigid airship construction.[386] While he offered no opinion of his own, he noted that all three service attachés assigned to Washington supported the wartime policy of full information exchange in light of the large increases in funding for experiments the American Navy and Army Air services had recently received – even as he acknowledged the Americans had previously derived more benefit than the British from the arrangement.[387]

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[384] Minute 21 to D.G.S.R. by D. of R., 5 Dec 19, TNA: AIR 5/489.
[385] Viscount Grey, Telegram No. 1678, 16 December 1919, TNA: AIR 5/489, Document 23A.
[386] Viscount Grey, Telegram No. 1678, 16 December 1919, TNA: AIR 5/489, Document 23A.
[387] Viscount Grey, Telegram No. 1680, 16 December 1919, TNA: AIR 5/489, Document 23A.

At the Foreign Office, Grey's note triggered an effort to coordinate a response from the Services. The Services, having already decided to cut back on sharing, were in no hurry to respond. It took until late December for the Admiralty to reply. It repeated the policy that Secret information should only be provided in the case of joint operations and Confidential information only exchanged for similar information.[388] The Air Ministry confirmed its similar policy – the Director of Intelligence now fully behind it as necessary to protect the British aircraft industry. He excepted only the airship because the Americans had agreed to purchase such a craft from Britain and so needed full access to its technical details.[389] That the Embassy in Washington noted the Americans might choose to seek information on airship construction from the Germans if the British cut them off, probably re-enforced this position.[390]

In early January 1920, the situation in Washington shifted before the British provided any response. Facing criticism within the U.S. Navy, the American Director of Naval Intelligence retracted his earlier policy ending free exchange of information and sought to reset to the wartime policy of exchange. The Embassy recognized the delicacy of the situation and suggested to London the whole matter be forgotten.[391] The American flip-flop did not matter to the Air Ministry and Admiralty, however, as they had already decided to replace their open technology sharing policy with a minimal technology sharing policy

In late January, the Foreign Office responded with the ironic statement that Secret information would not be shared unless in a joint operation and confidential matters would be

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388 Admiralty Letter M.05212 to Foreign Office (signed. P.E. Marrack for Secretary), 23 December 1919, TNA: AIR 5/489, Document 24B.
389 Minute 24 by DOI "For CAS", 29 December 1919, TNA: AIR 5/489.
390 Mr. Lindsay in Washington to Foreign Office, Telegram No. 7, 8 January 1920, TNA: AIR 5/489, Document 28A.
391 Mr. Lindsay in Washington to Foreign Office, Telegram No. 7, 8 January 1920, TNA: AIR 5/489, Document 28A.

exchanged only on an individual basis as quid pro quo but beyond that it was "thought that as wide an interchange of information as possible" was "desirable on general grounds."[392] The transmission of airship technology would continue and the technical representative would return to the United States in the spring because of the purchase of the airship by the United States.[393] The Embassy in Washington noted this new system was essentially the same as that the American Director of Naval Intelligence had proposed and would be easy to achieve. It noted only that exchange with the U.S. Army still seemed free flowing, and so the Army Attaché sought to maintain the previous system.[394]

As a result, the British sought to maintain what benefit they could from the Americans by disguising the shift in their policy. The Air Ministry, though recognizing that it was really up to the Foreign Office how to disclose the change in policy, recommended the British avoid discussing the change of policy explicitly to the extent possible.[395] The Embassy in Washington wanted to present the new systems as only applying to information that was "too confidential" to be given without exchange.[396] So it was that most of the open exchange of scientific and technical information that characterized the wartime period came to an end.

What drove these changes? Clearly, the end of the German threat and the wartime need for collaboration was paramount. In determining their final policy, both the Air Ministry and the

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[392] Foreign Office Telegram to Mr. Lindsay (Washington) No. 119, 30 January 1920, TNA: AIR 5/489, Document 35A.
[393] Foreign Office Telegram to Mr. Lindsay (Washington) No. 119, 30 January 1920, TNA: AIR 5/489, Document 35A; J.A. Webster, Air Ministry Letter S.12764(S.9) to Foreign Office, 5 February 1920, TNA: AIR 5/489, Document 36A.
[394] Mr. Lindsay in Washington to Foreign Office, Telegram No. 88, 2 February 1920, TNA: AIR 5/489, Document 37B.
[395] Air Ministry Letter S.12764/S.6 to Foreign Office, March 1920, TNA: AIR 5/489, Document 42A.
[396] Mr. Lindsay in Washington to Foreign Office, Telegram No. 88, 2 February 1920, TNA: AIR 5/489, Document 37B.

Admiralty agreed that the only reason to share secret technical information was if engaged in a joint operation with an allied power. The desire to provide special treatment to France, Britain's most likely future ally, re-enforces this perspective. Geo-strategic motivations remained the strongest motivation to share, and with the apparent end of the German threat, the major motivation for sharing ended as well. Absent this impetus to share, the barriers to sharing seemed more salient. For the Air Ministry, the barrier which was repeatedly cited was the need to secure advantage for the British aviation industry. The Air Ministry was invested in maintaining the industry for two reasons. First, it controlled both military and civil aviation – a combination of the modern U.S. Federal Aviation Administration and the Department of the Air Force – so preserving the industry was a direct part of the Air Ministry's mission. Second, and probably more importantly, a strong aviation industry was widely seen as essential for war preparedness.[397] Other reasons the Air Ministry resisted information exchange included concern for providing another power with technical information that could transform the use of the airplane in war and its belief the British had little to gain compared to the Americans from on-going exchange.

The single exception the Air Ministry supported re-enforced the importance of the economic barrier to sharing. The clear case where the Air Ministry supported detailed sharing of

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[397] Frederick Sykes, the Controller-General of Civil Aviation in this period wrote in his 1922 book, "It is obvious therefore that the capacity of the construction industry to expand cannot be fostered by service aviation alone; furthermore, in the event of another war of attrition, expansion will be more essential than any amount of machine reserve power immediately available, and in the event of a war of short duration that power will win which has the greatest preponderance of machines, service or civil, fit to take the air." Similarly, a book length supplement from Times of London on aviation published in 1918 concluded, "It has been said that the wars of the future will be fought in the air and will undoubtedly be won by that nation possessing in addition/to a strong air fleet the largest reserve of pilots, commercial and other aircraft, and of aircraft factories which can be called upon in case of emergency. From this point of view, it is obvious how important it is to us that commercial aviation and flying generally should be encouraged in every possible way."
Sykes, *Aviation in Peace and War*, 109; Times of London, *The British Aircraft Industry, Its Industrial and Commercial Potentialities*.

technological information was in the case of airships, where the United States had agreed to purchase an aircraft. In this case, withholding technical information would have hampered British industry. Indeed, this exception foreshadowed the situation in which the British would be more likely to share technical information – when it was bundled with the potential for sales for British firms.

Pure Quid Pro Quo

With the definitive end of the wartime policy of open exchange of information (at least as far as the Air Ministry was concerned) in early 1920, the key points of discussion surrounding the potential for information exchange over the next two and half years focused, with one exception, on specific requests for quid pro quo exchange of information that received sufficient attention to rise to senior levels.

Between 1920 and June of 1922, the Air Ministry considered quid pro quo exchanges of information with the Americans that required senior involvement three times: over experiments in the bombing of ships from aircraft, over experimental aircraft, and over barrage balloons. Additionally, the War Office proposed ongoing sharing of research and development information. Of these four discussions, only the exchange of experimental aircraft information occurred.

First, in March of 1921, the Americans made multiple inquires to the British related to Project B – the experiments on the bombing of ships. The First World War had witnessed the first use of aircraft in war, and both the technical sophistication of aircraft themselves and tactics for their use developed rapidly during the conflict. Airpower enthusiasts quickly came to believe aviation would revolutionize every aspect of warfare, and a vigorous debate ensured. The most public and contentious part of this debate in the United States occurred between U.S. Army flyers, led by the Deputy Chief of the U.S. Army Air Service, Brigadier General Billy Mitchell and a portion of the U.S. Navy's leadership including Woodrow Wilson's Secretary of the Navy Josephus Daniels. Mitchell sought a unified and independent air force on the British model. Mitchell thought demonstrating that airplanes could sink a battleship – the most highly armored and compartmentalized class of warship – would provide an irrefutable demonstration of airpower's potential. When the British Government created the Air Ministry and the Royal Air Force during the First World War, it had stripped the Royal Navy of its air service. As a result, in the early 1920s the Royal Navy did not control the planes or the pilots which flew from its aircraft carriers, the Royal Air Force did. While many in the U.S. Navy saw the potential for airplanes in naval warfare, they were determined not to let their flyers suffer the fate of the Royal Navy's.[398] After much debate, the Army and Navy agreed to conduct a series of experiments, called Project B, in which aircraft would attack ships of varying sizes culminating in bombing the former German dreadnaught battleship *Ostfriesland* – a prime example of modern battleship design. The experiments would take place in June and July 1921.

As the Americans prepared for Project B, they made two requests of the British. First, the U.S. Army asked if the Air Ministry might be able to supply the bombs for the experiments.[399] Second, the U.S. Navy requested information on the results of the Admiralty's experiments bombing the former German battleship *Baden*.[400] The British naval attaché in Washington suggested the British could use either request to secure a quid pro quo for the results of the

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398 Horwood and Price, "'A Fundamental Weapon': The Transatlantic Air Power Controversy of the 1920s and the US Navy as a Learning Organization."

399 Mitchell wanted to have his aircraft carrier the largest bombs possible for the tests, so to have the greatest likelihood of sinking the *Osfriesland*, but the U.S. Army had never developed a bomb over 1,100 lbs. The Army most likely made this enquiry to save itself the need to develop bigger bombs. As it happened, the Army would successfully develop new 2,000 pound bombs in time for the tests that summer, despite original estimates that the development would take far longer. Mitchell, *Winged Defense*, 51; Levine, *Mitchell, Pioneer of Air Power*, 222.

400 Captain Geoffrey Blake, Naval Attaché British Embassy Washington, Cable to Director Naval Intelligence Admiralty, 9 March 1921, TNA: AIR 5/489, Document 47A.

American tests.[401] The Air Ministry refused the initial American requests to share their information about testing battleship bombing, resulting in the Air Attaché expressing fear the Americans might reduce the information they supplied him. The Attaché thought the information the British could gain from the American bombing experiments would be well worth a trade.[402] Many in the Air Ministry agreed. While the staff of the Air Ministry Director of Intelligence dismissed the work of the American experimental stations in general, they knew the British battleship bombing experiments had been of much smaller scale and saw much benefit to a potential exchange.[403] Still, the Air Ministry recognized they would need to convince the Admiralty to support such an exchange.[404]

The Admiralty, as was typical, disagreed. They cited that they felt the British had come out on the losing end of the First World War technology exchange. Further, they believed the British experiments had been more methodologically sound than what the Americans proposed to do.[405] Still, they wanted to avoid antagonizing the Americans, and so recommended an "evasive reply."[406]

Staff officers in the Air Ministry suspected that the Admiralty just did not want to learn more about the bombing of ships, but more senior officer disagreed.[407] The Air Ministry Director of Intelligence countermanded his staff and agreed with the Admiralty. In late May, he directed the Air Attaché that the only way Christie should expect to get the test results directly from the

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[401] Captain Geoffrey Blake, Naval Attaché British Embassy Washington, Cable to Director Naval Intelligence Admiralty, 9 March 1921, TNA: AIR 5/489, Document 47A.
[402] Cutout "from serial letter No 42 from AA Washington", 15 April 1921, TNA: AIR 5/489, Document 45A.
[403] Minute 45 by Wing Cdr W Wynn to DDOI, No date [May 21], TNA: AIR 5/489; Minute 46 by John Chamers DDOI to AI, 9 May 21, TNA: AIR 5/489.
[404] Minute 46 by John Chamers DDOI to AI, 9 May 21, TNA: AIR 5/489.
[405] The British experiments were actually inferior to what the Americans did both in methodology and scope. These tests are further discussed later in the chapter.
[406] Charles Walker, Admiralty Letter M.0764 to Air Ministry, 18 May 1921, TNA: AIR 5/489, Document 47A.
[407] Minute 47 by W. Wynn, Wing CDR to DDOI, 19 May 21, TNA: AIR 5/489.

Americans would be if the Americans again asked to use British bombs for the experiment.[408] The British would trade munitions but not information. Ironically, the Air Ministry's excuse for refusing information on the British experiments was that if the British shared the information with the Americans, they might be forced to share it with the Japanese as well.[409] In June, after the American experiments had already begun, the full Air Council agreed that the British should refuse to disclose any information to the Americans about the Baden experiment.[410]

September of 1921 saw the British take, at least briefly, a more favorable approach to technology exchange with the Americans. The Americans suggested and received an exchange of information on experimental aircraft. The British provided "specifications on contracts for experimental reconnaissance, troop-carrying, fleet gunnery spotting, and long-distance bombing aeroplanes" along with a detailed report, including photos, of the Napier Cub Engine.[411] In return the Americans supplied specifications on in-service aircraft and a reversible propeller design. While the Air Ministry routinely shared low-level information with a variety of partners, this exchange stood out because it involved the transfer of secret information. The Air Ministry even made a specific point of informing the Air Attaché in Washington of the unusual exchange.[412]

The same month, the War Office proposed a major new sharing effort with the United States. Looking fondly back on the sharing during the war years, the War Office believed research progress may have gone faster had the sharing program continued. As such, it proposed

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[408] Minute 48 by Jon Chalmers DDOI to AI and S6, 21 May 21, TNA: AIR 5/489.
[409] Minute 48 by Jon Chalmers DDOI to AI and S6, 21 May 21, TNA: AIR 5/489.
[410] J.A. Webster, Air Ministry Letter S.21764/S.6. to Admiralty, 30 June 1921, TNA: AIR 5/489 No Document number.
[411] Letter from Air Staff Director of Operations & Intelligence to Air Attaché, British Embassy, Washington, 14 September 1921, TNA: AIR 5/489, Document 50A.
[412] Letter from Air Staff Director of Operations & Intelligence to Air Attaché, British Embassy, Washington, 14 September 1921, TNA: AIR 5/489, Document 50A.

"full exchange of information … regarding the development of scientific and mechanical research … in particular … gun, tank and tractor construction, and gas warfare."[413] The War Office was particularly concerned that reductions in defense spending would lead to further slowing of progress on military research, which it hoped technical collaboration with the Americans would offset. Seeking to convince the Air Ministry and Admiralty to support their proposal, the Army acknowledged risks in sharing, but suggested that since the Americans already had all the "pre-war and war-time manufacturing secrets" there was not much more to lose.[414]

The War Office proposal did not find a receptive audience. It took two months, until late November, before the War Office received a substantive response. As had become the pattern, the Admiralty announced its concurrence with all the risk the War Office acknowledged, added more, and opposed the proposal.[415] The Air Ministry provided a more nuanced answer. It noted that the Washington Conference, which had begun in November, was in progress, and suggested that the three services ought to consider technological exchange with the United States once the discussions in Washington concluded.[416] The War Office quickly agreed with the Air Ministry proposal and tabled the issue.[417] After the Conference concluded, no one ever raised the Army's proposal again.[418]

It was several months later (and after the conclusion of the Washington Conference) before a potential technology exchange that attracted attention occurred again. In March 1922,

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[413] War Office Letter 0153/4865 (M.I.2.) to Air Ministry, 28 September 1921, TNA: AIR 5/489, Document 52A.
[414] War Office Letter 0153/4865 (M.I.2.) to Air Ministry, 28 September 1921, TNA: AIR 5/489, Document 52A.
[415] Admiralty Letter M.01599 to War Office, 26 November 1921, TNA: AIR 5/489, Document 59B. Sent to Air Min on 2 Dec.
[416] Air Ministry Letter S/12764/S.6 to War, 2 December 1921, TNA: AIR 5/489, Document 61A. Similar letter sent to Admiralty.
[417] War Office Letter 0153/4865 M.I.W to Air Ministry, 16 December 1921, TNA: AIR 5/489, Document 62A.
[418] A.R. Boyle, "Notes on the question of the Exchange of Information between U.S.A. and ourselves" for DCAS, 22 May 1924, TNA: AIR 5/489, Document 110A.

the U.S. Army's Air Service requested "all obtainable information relating to English Barrage Balloons."[419] During the First World War, the British had developed the balloon as an anti-aircraft defense. The balloons, which looked like small blimps, held vertical wires aloft as well as horizontal wires which connected the vertical wires to create a net into which it was hoped German aircraft might crash. The system was only minorly effective. The British did not credit it with bringing down any enemy aircraft, but they did believe that it may have forced pilots to fly higher and potentially longer routes to avoid the net.[420]

In response to the American request, the Air Ministry provided some basic information about the system, but beyond that, because the War Office was responsible for Air Defense, it could only refer the American Air Attaché in London to the officers who had designed the system.[421] In a turnabout from the War Office proposal for technology sharing a few months before, when the Americans had asked the War Office for specifications on the balloons, they were refused because the information was deemed "confidential."[422] The Americans complained to the Air Ministry, who were surprised. Air officials did not seem to believe anything was confidential about barrage balloons, and their effectiveness was questionable.[423] Still, the War Office controlled the information, even if the Air Ministry feared the Americans would retaliate against it. The Air Attaché in Washington suggested the U.S. Army Attaché provide a detailed

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[419] O.N. Solbert and C.C. Benedict, Letter A.B. 671 to Captain Adams, 13 March 1922, TNA: AIR 5/489, Document 63A Appendix no. 1.
[420] F.P. Adams, Air Ministry Letter 332409/22 to Major Benedict, 17 March 1922, TNA: AIR 5/489, Document 63A Appendix no. 1.
[421] F.P. Adams, Air Ministry Letter 332409/22 to Major Benedict, 17 March 1922, TNA: AIR 5/489, Document 63A Appendix no. 1.
[422] C. Sinclair Stevenson, War Office Letter 1853 M.I.2 (a) to Major O.N. Solbert, American Military Attaché, 6 April 1922, TNA: AIR 5/489, Document 63A Appendix no. 1.
[423] Para 4 from Serial Letter No 2 Received from AA Washington, 18 May 1922, TNA: AIR 5/489, Document 63A.

list of questions to the War Office in hopes that some could be answered without providing confidential information.[424] Another quid pro quo transfer had failed.

DV

1. Did the British support any sharing of military related technology? If yes, what technology sharing policy did the unit support?

Yes. The Air Ministry, Admiralty, and War Office all supported some form of continued technology sharing with the United States after the war. The debate that occurred both within and between ministries was over how liberal that technology sharing policy should be.

The three ministries did not always agree how liberal technology sharing should be. Initially, there was disagreement even within the Air Ministry as to whether it should continue ongoing sharing with the Americans. The leaders of the Air Ministry's technology and research arms opposed a specified sharing policy from the beginning.[425] The Air Ministry's intelligence arm preferred an on-going sharing arrangement, but one less liberal than had existed during the war.[426] Hugh Trenchard, the Chief of the Air Staff, initially favored a more liberal policy, particularly when he thought the Admiralty pursued such a policy. He later shifted to preferring individual evaluation of one-off transfers, which became the final policy.[427] Because the Air Ministry never issued an official policy of continuing ongoing sharing, I code this entire period as one of minimal transfer.

The Admiralty, on the other hand, consistently opposed any ongoing technology sharing with the United States. It always accepted, however, that in some circumstances technology

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424 Para 4 from Serial Letter No 2 Received from AA Washington, 18 May 1922, TNA: AIR 5/489, Document 63A.
425 Minute 4 to DGSR by DOR Robert Brook-Popham, 10 June 1919, TNA: AIR 5/489; Minute 5 to CAS by DGSR, 12 June 1919, TNA: AIR 5/489.
426 Minute 14 to CAS by D.O.I, 15 Oct 1919, TNA: AIR 5/489.
427 Minute 17 to DGSR by CAS, 12 Nov 1919, TNA: AIR 5/489; Minute 15 to DGSR by CAS, 16 Oct 1919, TNA: AIR 5/489.

sharing would be beneficial. Thus, the Admiralty supported a minimum technology sharing policy with the United States whereby information would only be shared as part of individually approved one-off exchanges.[428]

Finally, the War Office generally agreed with the other two ministries, favoring a minimal technology sharing policy. The War Office stated it supported the Admiralty's one-off, quid pro quo approach.[429] It briefly suggested a more liberal approach in the fall of 1921 when it proposed a "full exchange of information…regarding … scientific and mechanical research" with the U.S. Army.[430] Serious consideration of this proposal, however, was postponed until after the Washington Conference, and never taken up again. As such, like the other ministries, the War Office's technology sharing policy throughout this period was minimal.

TOTT

1. What motivations, if any, did decisionmakers have to share technology?
    a. Did the sharing state face severe and immediate threat that it shared with the potential recipient state?

No. While the United States and Britain had both fought Germany during the First World War, with the signing of the armistice that threat began to recede. With the conclusion of the negotiations that produced the Versailles Treaty in 1919, the threat disappeared for the foreseeable future. Indeed, in general the British government felt unthreatened enough to adopt the "Ten Year Rule" in August 1919, which used as a planning assumption that Britain would not face a great war during the next ten years.[431]

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[428] Admiralty Letter M.05212 to Foreign Office, 23 December 1919, TNA: AIR 5/489 Document 24A.
[429] Min 64 to AI by C. G. Eyarm. 5 July 21, TNA: AIR 5/489.
[430] War Office Letter 0153/4865 (M.I.2.) to Air Ministry, 28 September 1921, TNA: AIR 5/489, Document 52A.
[431] Paul Kennedy, *The Rise and Fall of British Naval Mastery*, Humanity Books Edition (Amherst, NY: Prometheus Books, 1983), 273.

b. Did any decisionmakers' organizations face any severe threat to their existence, independence, or ability to accomplish their goals?

Yes. As discussed in the previous chapter, the Air Ministry was under significant pressure in this period. The British government had created the Air Ministry during the war in what many thought would be a temporary measure. Not until 1924 was the Royal Air Force's independence secured. Throughout the early 1920s the War Office and the Admiralty sought the break-up of the Royal Air Force and the return of their flying services. To compound the Air Ministry's challenges, the British aviation industry, for which it was responsible, faced a severe contraction with the disappearance of wartime demand and a large surplus of wartime aircraft. The number of British firms manufacturing aircraft cratered in these years, and many firms that continued to make aircraft needed to produce other items as well to stay afloat. Unable to secure more funding domestically, the Air Ministry promoted overseas sales to help support industry.

Unlike with Japan, technology sharing with the United States did not seem to help address those threats. The Air Ministry believed that providing British technology to the Americans would only harm the competitiveness of their own struggling firms. Because the United States had its own nascent aircraft industry, it did not seem that British technology would be likely to create a future market for British firms. The exception might have been in airships, but the disastrous crash of R.38 in 1921 ended the American interest in British airships. Thus, while the Air Ministry faced threats, technology sharing with the United States did not seem likely to mitigate them.

In discussions about continuing more open technology sharing in this period, Air Ministry officials generally cited two reasons to share. In the specific case of airships, the Air Ministry noted that the technology sharing was part of the contract for the sale of R.38 and had already been agreed.[432] This economic logic was unique to this case. Air Ministry officials also argued that a more liberal technology sharing policy across the board would make it easier to gain information from the Americans and keep up with their developments.[433] In essence, they believed more technology sharing would ease collection of technical intelligence.

The Admiralty did not appear to face any significant organizational threats during this time. The closest thing to such a motivation was the Washington Conference, which produced a naval arms limitation treaty. While the Admiralty did not like the formal establishment of size parity with the United States, it also recognized that the U.S. could easily outbuild it in capital ships. And though it had accepted parity in capital ships, the British negotiators had forestalled extending overall limits to smaller ships.[434] As a result, the treaty did more to mitigate than create threats, and the British, including the Admiralty, generally recognized this.[435]

Similarly, the War Office did not face any existential organizational threats during this time, though the 10-year rule had the most dramatic effect on its budget. It is significant to note, however, that the War Office's proposal for a more liberal technology sharing policy toward the United States was driven by reductions in its budget.[436] Thus, when the War Office did consider a more open technology sharing policy, a threat to its organizational interests motivated that consideration. Why the War Office never pursued Anglo-American technology sharing further is unclear.[437] In general, however, during this period, no threats to organizational interests existed which technology sharing could help mitigate.

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[432] J.A. Webster, Air Ministry Letter S.12764(S.9) to Foreign Office, 5 February 1920, TNA: AIR 5/489, Document 36A.
[433] Minute 14 to CAS by D.O.I, 15 Oct 1919, TNA: AIR 5/489.
[434] Liso, *British Naval Supremacy and Anglo-American Antagonisms, 1914-1930*.
[435]Roskill, *Naval Policy between the Wars*, 330.
[436] War Office Letter 0153/4865 (M.I.2.) to Air Ministry, 28 September 1921, TNA: AIR 5/489, Document 52A.
[437] On topic requiring further research is Anglo-American chemical weapons cooperation during this time. Some evidence suggest robust technical exchange may have occurred in this period. In the aftermath of the war, public revulsion at chemical weapons may have led to a serious threat to chemical warfare services of both countries.

2. How did sharing state decisionmakers assess future interest alignment with the potential recipient state?

As previously discussed, throughout the early 20th Century, the British government consistently assessed that a conflict with the United States would be disastrous for Britain strategically and economically. It also seemed "unnatural."[438] As such, the British had worked assiduously to avoid and reduce tensions with the United States since at least the turn of the century, but after the First World War, Britain faced a new situation. Britain's traditional continental enemies had suffered heavily during the war, many had succumbed to revolutions. Some, especially in the Royal Navy, started to see the United States as the pacing "threat" if only because it was the only state building a Navy with a capability that could threaten Britain even if it appeared to have no intention of doing so. The Admiralty even considered drawing up an American war plan.[439] In August 1919, the Cabinet sought to head off the potential of the Royal Navy using the U.S. Navy's growth to justify a larger fleet by reaffirming the 1909 decision that the American fleet should not be used as the basis for the Royal Navy's size.[440] The British even passed this decision to the Embassy in Washington in an effort to mollify the Americans.[441] While the Admiralty complied, the decision did not fully end the discussion.[442]

Soon after the war tensions arose again over naval construction. As discussed in the previous chapter, in 1916 the United States had set out to build a Navy "second-to-none." This rankled the British, who had traditionally dominated the seas, but who could not afford to compete in naval construction with the United States. In some quarters, fear existed that a new

438 Kennedy, "The Tradition of Appeasement in British Foreign Policy 1865-1939," 202.
439 Bell, "Thinking the Unthinkable," 791.
440 Bell, 791.
441 Nish, *Alliance in Decline*, 284.
442 Bell, "Thinking the Unthinkable," 792.

naval arms race could push the United States and Britain apart just as many believed the Anglo-German naval race before the Second World War had done.

In December 1920, the Committee of Imperial Defence analyzed the security situation in the Pacific. The key question was whether Britain should begin an aggressive shipbuilding program. The British Prime Minister David Lloyd George explained his thoughts. First, Britain needed to determine its "probable enemy."[443] Lloyd George "ruled out Germany, Russia, Italy, and … France as potential antagonists in the immediate future."[444] The only potential challengers to British power were Japan and the United States, both friendly. Lloyd George insisted Britain could not afford to consider the United States an enemy. The Canadian border was indefensible. The British owed the Americans too much money. He feared a naval competition with the United States would be "disastrous."[445]

Most of the rest of the British Government agreed. The Foreign Office viewed the United States a "friend who is united to us by race, tradition, community of interests and ideals."[446] "Not antagonizing the United States" was a "dominating factor" in British considerations.[447] The War Office concurred. It noted: "We cannot afford to regard America as a potential enemy."[448] Most Royal Navy officers felt similarly. The Chief of the Naval Staff Lord Beatty thought the United States was "allied to us in blood, in language, and in literature and with whom [the British] share[d] the mutual aspiration of maintaining the peace and progress of the world."[449]

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443 Quoted in Louis, *British Strategy in the Far East, 1919-1939*, 52.
444 Louis, 52.
445 Quoted in Louis, 53.
446 "Memorandum by Mr. C.H. Bentinck on the Effect of the Anglo-Japanese Alliance upon Foreign Relationship." 28 Feb 20, TNA: FO 371/5358, F199/199/23, p.161.
447 "Memorandum by Mr. C.H. Bentinck on the Effect of the Anglo-Japanese Alliance upon Foreign Relationship." 28 Feb 20, TNA: FO 371/5358, F199/199/23, p.162.
448 B.B. Cubitt, "War Office to Foreign Office (Received February 14, 1920)," TNA: FO 371/5358, F199/199/23, p.164.
449 Quoted in Bell, "Thinking the Unthinkable," 792.

Nonetheless, the situation was not quite so simple. Though the Admiralty desired to avoid a conflict with the United States, it feared it might happen. If Britain ended up at war with some other power which the Royal Navy blockaded, British officers feared a conflict over neutral rights could inadvertently bring the United States and Britain to blows, especially if an arms race had already raised tensions.[450] Others in government saw the tension in the Anglo-Japanese Alliance. Having mostly ruled out the United States as Britain's potential threat, the remaining option was Japan, which the British never ruled out in the same way.[451] The British, however, were still allied to the Japanese in 1920. Many Americans saw themselves as the only potential remaining target of this alliance.[452] Some British leaders thought this situation meant Britain should jettison the alliance to ensure comity with the United States. Others feared the effect this would have on Japan, and thought the alliance might make the United States less adventurous.[453] Navigating this issue added an additional complication to Anglo-American relations, thus, while few in either government seriously believed a conflict between the United States and Britain was likely, few in Britain were willing to fully rule out the possibility – at least until after the Washington Conference which would put to rest both the concern about a naval arms race and the issue of the Anglo-Japanese alliance.

3. Did the decisionmakers express concerns about the ability of the recipient state to protect technological secrets?

Yes. The British tended to believe that the American government leaked like a sieve. One reason the Admiralty argued that Britain should not exchange results of battleship bombing

[450] Bell, 794; MacMillan, "Isosceles Triangle," 12.
[451] Louis, *British Strategy in the Far East, 1919-1939*, 54; Field, *Royal Navy Strategy in the Far East 1919-1939*, 17; Nish, *Alliance in Decline*, 284–85.
[452] Nish, *Alliance in Decline*, 281.
[453] Louis, *British Strategy in the Far East, 1919-1939*, 52–54.

experiments with the United States was that they believed the Americans would be unable to keep the results of their experiments out of the papers – allowing the British to learn from them for free.[454] The Admiralty feared any British information provided to the United States would leak too.[455] Similarly, when the War Office proposed open technology sharing with the United States in 1921, it noted "there appears to be no such thing as secrecy in the United States."[456] The Air Ministry also acknowledged that much U.S. government information appeared in the press, but seemed to have more confidence the United States could protect British information if asked to do so.[457]

What led the British to this position? While no smoking gun exists, the aviation vs. battleship debate in the United States likely shaped the British view. The U.S. Navy's initial experiments in which aircraft attacked ships took place from 28 October to 3 November 1920 and with former USS Indiana as the target. The experiments were secret. The Navy allowed Army observers, including Billy Mitchell, but they provided no information to the press. Nonetheless on 11 December 1920, the London Illustrated News dropped a bombshell. It published two photos showing heavy damage to the USS Indiana. Six weeks later, the New York Tribune published seven photos of the test results and an editorial heavily criticizing the Navy.[458] The episode brought the controversy to the fore. Congress held hearings in which various senior Army and Navy officials testified about the potential for aircraft and the experiments. The hearings helped lead to Project B. When the Project B tests occurred, they were highly public. For each test event, the USS Henderson, a transport, brought "high officials, ranking officers of

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[454] Charles Walker, Admiralty Letter M.0764 to Air Ministry, 18 May 1921, TNA: AIR 5/489, Document 47A.
[455] Admiralty Letter M.01599 to War Office, 26 November 1921, TNA: AIR 5/489, Document 59B.
[456] War Office Letter 0153/4865 (M.I.2.) to Air Ministry, 28 September 1921, TNA: AIR 5/489, Document 52A.
[457] Min 54 by W. Wynn Wing Commander to DOI, 3 Nov 1921, TNA: AIR 5/489.
[458] Levine, *Mitchell, Pioneer of Air Power*, 206–8.

the army and navy, members of Congress, diplomatic representatives and a party of newspaper correspondents."[459] Even though members of the British staff did not receive access to the detailed technical assessments the Navy made during the experiments, they could watch themselves and read press stories. The entire episode likely helped convince the British both that the Americans could not keep secrets from the press and that the British might be able to benefit from the American's leakiness without giving anything up.

In summary, the end of the First World War soon brought an end to the open technology sharing policy between Britain and the United States. No severe mutual threat existed to motivate continued open sharing. The Air Ministry faced strong pressure, but technology sharing with the United States did not obviously help alleviate it. While British decisionmakers generally saw affinity between U.S. and British interests and wanted to avoid conflict, the potential for a naval arms race strained relations. The British also worried about the ability of the United States to keep a secret. As a result, all the British service ministries came to prefer a minimal technology sharing policy of one-off, quid pro quo transfers.

Single-Period Structural Realism & Technological Capability

Since this alternative explanation expects current shared threats to drive technology sharing, it would predict that the end of the immediate German threat that accompanied the end of the First World War would lead to the end of Anglo-American technology sharing. As such, this theory would predict all ministries of the British government would prefer a "none" technology sharing policy during this period. While British and American technology sharing did decrease significantly within six months of the end of the war, it did not cease as this explanation predicts.

[459] Levine, 232.

Economic

This alternative explanation argues that states share technology for economic benefits and withhold technology when it risks their economic competitiveness. In the Post-War period, economic reasoning appeared in the Air Ministry.

1. Did the sharing arrangement involve monetary payments to a sharing state?

One instance of technology transfer under the auspices of the Air Ministry appeared to involve a monetary payment: the sharing of airship technology with the United States. The Royal Navy had originally intended to purchase four airships for use in anti-submarine patrols during the First World War. After the end of the war, responsibility for the airships was transferred to the Air Ministry, and the orders for all but one of the airships were cancelled. The British offered the partially constructed airship R.38 to the United States, which chose to purchase it in October 1919. When the U.S Director of Naval Intelligence first decided to end the wartime system of open information exchange in December of 1919, the British Ambassador Lord Grey arranged for the British airship expert teaching construction techniques in the United States to leave.[460] When the Air Ministry decided to shift to a policy of one-off exchange as a response, it specifically excepted airships because the Americans had decided to purchase R.38, and the expert would later return to the United States.[461]

2. Did leaders cite economic benefits as an important rationale or haggle over them?

No evidence appears in the conversations about the technology sharing policy towards the U.S. that cites the particular importance of the airship project, but the British did note that the instruction on airship construction techniques had been part of the sale contract.[462] I did not,

[460] Viscount Grey, Telegram No. 1678, 16 December 1919, TNA: AIR 5/489, Document 23A.
[461] Minute 24 by DOI "For CAS", 29 December 1919, TNA: AIR 5/489; J.A. Webster, Air Ministry Letter S.12764(S.9) to Foreign Office, 5 February 1920, TNA: AIR 5/489, Document 36A.
[462] J.A. Webster, Air Ministry Letter S.12764(S.9) to Foreign Office, 5 February 1920, TNA: AIR 5/489, Document 36A.

however, review documents about the negotiations for the original sale. The Air Ministry leadership did discuss the possibility the United States could get airship information from the Germans if Britain did not provide it.[463]

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

Yes. In discussing reasons for ending the technology sharing arrangement that had developed between Britain and the United States during the war, Air Ministry officials repeatedly cited the need to protect the competitiveness of the British aviation industry as an important rationale for restrictions. The British sought specifically to protect the "results of research until [British] manufacturers [had] benefited."[464] Discussions also mentioned protecting major developments that could improve the military usefulness of aircraft.[465] This rationale appeared frequently in internal Air Ministry correspondence in the Post-War period.[466] It seems unlikely that economic logic affected the Admiralty's resistance to technology since it had nothing economically at stake in aviation technology sharing.

In summary, economic logic helps explain one of the multiple one-off transfers to the United States after the First World War, and the Air Ministry cited concerns about economic competition in its decision to reduce technology sharing after the war ended.

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[463] J.A. Webster, Air Ministry Letter S.12764(S.9) to Foreign Office, 5 February 1920, TNA: AIR 5/489, Document 36A.
[464] Minute 7 to CAS by R.M. Groves (DCAS), 27 June 1919, TNA: AIR 5/489.
[465] Minute 6 to DCAS by Lieutenant Colonel W. Wynn, 16 June 1919, TNA: AIR 5/489; Minute 7 to CAS by R.M. Groves (DCAS), 27 June 1919, TNA: AIR 5/489.
[466] Minute 6 to DCAS by Lieutenant Colonel W. Wynn, 16 June 1919, TNA: AIR 5/489; Minute 7 to CAS by R.M. Groves (DCAS), 27 June 1919, TNA: AIR 5/489; Minute 24 by DOI "For CAS", 29 December 1919, TNA: AIR 5/489.

Organizational

The organizational processes explanation expects that the SOPs of the ministries involved in making technology sharing decisions should shape technology sharing policy preferences. Generally, we should expect military organizations to resist sharing technology since armed forces usually protect information. This resistance should be particularly pronounced in peacetime. Scientific organizations usually favor technology sharing.

1. What was the role of military organizations in shaping the sharing decision?

The Air Ministry and Admiralty both had substantial input to technology sharing policy after the First World War. The Foreign Office looked to the service ministries for guidance on how to handle technology sharing with the United States when the United States stated it wanted to end open technology sharing.[467] Rarely did the ministries push the issue to the level of their civilian political leadership. On the rare occasions when civilian ministers were made aware of inter-ministry disagreements, no evidence exists those ministers chose to take up the issue.

2. If military organizations were involved in the decision, were those armed forces operating in close quarters with the potential recipient state's armed forces?

Once the war ended, British and American forces were no longer fighting in close proximity. Coordinated operation did not affect Air Ministry's perspective – the ministry with the most variable attitude toward technology sharing. Some U.S. Air Service squadrons would remain with the U.S. Third Army, assigned to occupation duty in Germany through November 1919, but the U.S. Air Service drew down rapidly after the armistice. On November 12, 1918, the American Expeditionary Forces ordered all pilots in England to cease training, causing major contention with the British. Thus, while American and British units remained in Europe after the

[467] Foreign Office Telegram to Mr. Lindsay (Washington) No. 119, 30 January 1920, TNA: AIR 5/489, Document 35A.

war, they were both shrinking quickly, and the two states were not actively coordinating air combat operations. As result, it is fair to say that the British and American air services were not cooperating in their operations soon after the end of the war.

3. What was the role of scientific organizations in shaping the sharing decision?

Independent scientific organizations do not appear to have been involved in technology sharing decisions in this period. Within the Air Ministry, the research and supply divisions were the most strongly opposed to technology sharing.[468]

Organizational theory suggests military and naval organizations should be averse to technology sharing in peacetime. These organizations have SOPs that prize security, and they often default to this position. Additionally, technology sharing creates the risk that an organization's experts could be revealed as technologically behind their equivalents in other states, potentially weakening their authority. Indeed, organizational factors, especially peacetime secrecy SOPs and their interaction with the inherent information asymmetries seemed to have been a major obstacle to technology sharing. These factors affected both the Admiralty and the Air Ministry. Given these factors, the organizational alternative explanation would hold that military organization SOPs should have influenced technology sharing policy. The service ministries should have supported technology sharing during the war and opposed it once the war ended. These predictions generally match what occurred after the end of the war.

Other events also highlight how organizational factors may have influenced technology sharing in this period. Most historians have marked the end of Anglo-American technology sharing in 1921 when the U.S. Navy refused a British offer to exchange information on acoustic

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[468] Minute 5 to CAS from DGSR, 12 June 1919, TNA: AIR 5/489; Minute 4 to DGSR by DOR Robert Brook-Popham, 10 June 1919, TNA: AIR 5/489.

research.[469] As we have seen, the story is more complicated, but the episode put a bad taste in the Admiralty's mouth. The next year, London directed the British Naval Attaché in Washington to prepare a report on U.S. Navy acoustic research, but he was directed not offer to exchange information. The report focused on hydrophones, and unsurprisingly given the restrictions, was disappointing. The Admiralty really wanted to know about American echo-detection research, but the Admiralty considered the topic so secret that initially they would not even tell the Embassy in Washington what they were looking for! When the Admiralty finally provided "a brief summary, marked 'very secret'" the embassy was able to compile a report on underlying technology that the Admiralty dismissed as inconclusive.[470] The Admiralty's concerns with protecting its own information made it difficult to get the information it wanted, which in turn made it more likely to conclude the Americans had nothing to offer. The Admiralty's culture of deference to seniors likely further exacerbated this problem.

Organizational factors also provide an alternative or additive explication for the Admiralty's seeming intransigence. The Admiralty had a rivalry with the Air Ministry, and it sought to regain control of its Air Service. The Admiralty was still interested in American sonar research, even though the extreme secrecy it applied to asdic prevented it from gaining what it sought. The Admiralty was also willing to provide some aviation information directly to the Americans in this period. In 1921, Admiral William Sims, President of the U.S. Naval War College, requested and received from the U.S. Office of Naval Intelligence details on British experiments with torpedo bombers. As part of the response, the British Admiralty provided a secret report on British development of such aircraft. The report included descriptions of

[469] Zimmerman, *Top Secret Exchange*; Hackmann, *Seek & Strike: Sonar, Anti-Submarine Warfare and the Royal Navy 1914-1954*, 257.
[470] Hackmann, *Seek & Strike: Sonar, Anti-Submarine Warfare and the Royal Navy 1914-1954*, 257.

technical features of aircraft and torpedoes and records of test runs.[471] What quid pro quo the U.S. Navy provided to receive this report is unclear.

Table 4-2: Theory Predictions and Actual Values for Technology Sharing Post-War

	TOTT	Structural Realism	Economic	Organizational	Actual Desired	Actual Observed
Air Ministry	Minimal	None	None/Share	None/Minimal	Minimal	Minimal
Admiralty	Minimal	None	None	None/Minimal	Minimal	Minimal

The Negotiation to Reestablish On-going Collaboration

In June 1922, the U.S. Navy decided to try a different approach. The Director of Naval Intelligence provided a sample of Navy aviation publications to the British Air Attaché in Washington and proposed an ongoing exchange of research and technical publications between the United States and Britain.[472] This offer marked the first of four phases of negotiations over the next two and a half years for the United States and Britain to agree to some form of ongoing exchange of military aviation research like what had occurred during the First World War. Every attempt eventually failed, and the two countries finally abandoned the effort in the fall of 1924.

This first attempt lasted through the late fall of 1922. The Americans initially stated the publications they provided were samples, but then quickly demanded a list of what they deemed equivalent publications be provided in return. They soon modified their position to suggest a six-month trial exchange period.[473] The Americans were especially interested in the Air Ministry's Director of Research Report, which summarized the most advanced British military aviation

[471] Horwood and Price, "'A Fundamental Weapon': The Transatlantic Air Power Controversy of the 1920s and the US Navy as a Learning Organization," 11.
[472] "List of Publications received from U.S. Director of Naval Intelligence,", 17 June 1922, TNA: AIR 5/489, Document 65A Appendix 1C; L. McNamee, Letter from U.S. Director of Naval Intelligence to M.G. Christie, British Air Attaché Washington, DC, 20 June 1922, TNA: AIR 5/489, Document 65A Appendix 1C.
[473] L. McNamee, Letter from U.S. Director of Naval Intelligence to M.G. Christie, British Air Attaché Washington, DC, 20 June 1922, TNA: AIR 5/489, Document 65A Appendix 1C.

research.[474] This report would prove a major sticking point throughout the entirety of the negotiation. The British Air Attaché refused but passed the issue of exchange on to London.[475] Within two weeks, the Admiralty communicated to the Air Ministry that it refused to approve any general exchange of publications, preferring to maintain a system of one-off quid pro quo exchange.[476] The Admiralty felt Britain had more to lose than it had to gain from a system of on-going exchange. It also provided a copy of draft instructions to the Naval Attaché in Washington to ensure the implementation of its policy. The Air Council confirmed that it agreed with the Admiralty position on July 25th.[477]

But while the senior leadership of the Air Ministry had declared it preferred a quid pro quo policy, lower-level officials worked to find a way in which the Air Ministry could claim compliance with a quid pro quo system while still initiating on-going exchange. Three days before the Air Ministry's confirmation to the Admiralty that the Air Council was for a strictly quid pro quo system of exchange, the Americans made a second attempt to initiate a system of ongoing exchange. Officials in Air Intelligence feared the Americans might cease all information exchange if the British could not offer something in return.[478] In late August, Air Intelligence, in coordination with the Air Ministry Director of Research, sent a counterproposal to Washington. The British offered several reports but only ones with information that was "non-secret, non-proprietary." They still requested confidential American reports.[479] The Air Ministry also urged their Attaché, Group Captain Malcolm Christie, to present this proposal to the Americans as a

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474 Letter No. 6 from Air Attaché, Washington, DC to Director of Air Intelligence, 30 June 1922, TNA: AIR 5/489, Document 65A.
475 Letter No. 6 from Air Attaché, Washington, DC to Director of Air Intelligence, 30 June 1922, TNA: AIR 5/489, Document 65A.
476 Charles Walker, Admiralty Letter M.0839/22 to Air Ministry, 3 July 1922, TNA: AIR 5/489, Document 64A.
477 Air Ministry Letter S.12764 to Admiralty, 24 July 1922, TNA: AIR 5/489, Document 67A.
478 Min 69 by W. Wynn, Wing Cdr for DOI to DOR, 29 July 22, TNA: AIR 5/489.
479 A.R. Boyle, Letter to Wing Commander Christie, 18 August 1922, TNA: AIR 5/489, Document 72B.

quid pro quo of American reports for the British. More importantly, the Air Ministry insisted that Christie needed to make a deal for *both* U.S. Army and U.S. Navy information.[480] London feared that any information granted to one service would inevitably be shared with the other.

Christie attempted to work these instructions. He began negotiating with his U.S Army contact the Chief of the Army Air Service's Information Division Major Horace Hickam – for whom the air base next to Pearl Harbor would later be named. By October, Christie thought he was making progress.[481] The U.S. Navy, however, insisted upon receiving the Director of Research Report, and Christie let the matter drop.[482]

In January 1923, the U.S. Navy attempted to re-start the negotiations, beginning their second phase. The American Director of Naval Intelligence Captain Luke McNamee wrote Christie that the U.S. Attaché in London had received seven British reports about tests of aviation engines, construction methods, and equipment.[483] The Americans, however, remained unsatisfied with the British counteroffer because it excluded the Director of Research Report. McNamee offered the same publications but suggested that the Americans would tolerate the British "cutting" particularly secret material out of the Director of Research Reports and the exclusion of material controlled by the Admiralty. He again suggested a six-month trial period.[484] Christie forwarded the proposal on to the Air Ministry hoping that the significant increase in

[480] A.R. Boyle, Letter to Wing Commander Christie, 18 August 1922, TNA: AIR 5/489, Document 72B.
[481] "Para 4 from Serial Letter No 12 received from AA Washington" 5 Oct 1922, TNA: AIR 5/489, Document 74A
[482] Cable A.A. No. 92 from Air Attaché, British Embassy, Washington to Director of Air Intelligence, 11 January 1923, TNA: AIR 5/489, Document 75A.
[483] L. McNamee, Director Naval intelligence Letter Op-16-A CRM: JL to M.G. Christie, British Air Attaché Washington, 8 January 1923, TNA: AIR 5/489, Document 75A Appendix 1.
[484] L. McNamee, Director Naval intelligence Letter Op-16-A CRM: JL to M.G. Christie, British Air Attaché Washington, 8 January 1923, TNA: AIR 5/489, Document 75A Appendix 1.

information requests he had received from the Director of Research about American technology might mean the Air Ministry would be ready to consider the deal.[485]

In London, it was not until April that the issue received serious consideration. When it did, the Air Intelligence Office made a valiant argument for increased exchange. It characterized the on-going exchange of publications as a form of quid pro quo. It cited the potential benefits to the Air Ministry's budget, noted the agreement would be subject to American promises of secrecy, and that there was "no prospective danger of America becoming an enemy."[486] Air Intelligence even made the same argument that had been used with the Sempill Mission about the pace of innovation: if problems arose, the exchange "could be stopped at once and little harm could result in view of the rapid change in design."[487] In the discussion that followed, further proposal to reduce risk ensued. The British discussed withholding certain details longer to ensure they could maintain their lead.[488] The Director of Research appeared to agree if the Radio Research Board agreed – since the report frequently contained information that affected all the services.[489]

Senior officials, however, rejected these arguments. Geoffrey Salmond, the Air Member for Supply and Research who had supported the Sempill Mission, was against sharing with the Americans.[490] The Air Ministry convened a conference with the Admiralty, which the Deputy

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[485] Cable A.A. No. 92 from Air Attaché, British Embassy, Washington to Director of Air Intelligence, 11 January 1923, TNA: AIR 5/489, Document 75A.
[486] A.R. Boyle, Memorandum on Exchange of Information, 6 Apr 1923, TNA: AIR 5/489, Document 76A.
[487] A.R. Boyle, Memorandum on Exchange of Information, 6 Apr 1923, TNA: AIR 5/489, Document 76A.
[488] Minute 78 by G. Carmichael WCmdr to DCAS, 7 Apr 23, TNA: AIR 5/489.
[489] Minute 80 by D. of R. to A.M.S.R, 19 Apr 1923, TNA: AIR 5/489. Created in 1920, the Radio Research Board, part of the Department of Scientific and Industrial Research, conducted research on radio waves and coordinated such research across the British Government to prevent duplication. If any of the reports under consideration for exchange involved technology for air-to-ground radios or any other equipment involving radio waves, the proposal required the Radio Research Board's approval. "Radio Research in Great Britain," *Nature* 131, no. 3316 (May 1, 1933): 720–720, https://doi.org/10.1038/131720a0.
[490] Minute 81 by AMSR to DCAS, 24 Apr 1923, TNA: AIR 5/489.

Chief of Air Staff attended along with the Admiralty Deputy and the British Director of Naval Intelligence. They categorically rejected the sharing proposal. They feared that "in the long run [Britain] has little to gain… and a great deal to lose, and that [their] policy must be to give as little as possible."[491] After a month of discussion, in mid-May the Air Ministry directed Wing Commander Christie in Washington to reject the American proposal.[492]

While London had been busy debating the American proposal, little had happened in Washington since the January proposal. But when the outgoing American Naval attaché in London returned to Washington, he reported that the British seemed much closer to approving an exchange of information – though it appears likely that his knowledge reflected only the feelings of the lower-level Air Ministry officials.[493] Thus, a little over a week after London rejected the American officer, Christie met in a joint conference with U.S. Army and Navy representatives on May 21st. They began the third phase of the negotiations in which the Air Ministry would begin shift its position. For the first time, the British were simultaneously negotiating with both the U.S. Army and Navy, and the major shift in the American negotiating position, besides an explicit commitment to protect the secrecy of British information, was to offer both Army and Navy publications as part of the exchange.[494] Christie forwarded these proposals to London, but asked the Air Ministry to delay any discussion until he returned to London on leave in June to consult on the matter.[495]

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491 Min 82 by DCAS to AMSR, 4 May 1923, TNA: AIR 5/489.
492 Air Ministry Directorate of Operations and Intelligence Letter S.12764/A.I.1. to Air Attaché British Embassy Washington, 10 May 1923, TNA: AIR 5/489, Document 83A.
493 M.G. Christie, Letter A.A. No. 280 from Air Attache British Embassy Washington to Director of Air Intelligence, Air Ministry, 28 May 1923, TNA: AIR 5/489, Document 85A.
494 W.K. Naylor and L. McNamee, Joint War Department Navy Department Letter No. Op-16-A NWH:ALH to Colonel Christie, 24 May 1923, TNA: AIR 5/489, Document 85B.
495 M.G. Christie, Letter A.A. No. 280 from Air Attache British Embassy Washington to Director of Air Intelligence, Air Ministry, 28 May 1923, TNA: AIR 5/489, Document 85A.

This intervention succeeded – at least within the Air Ministry. In August, Christie and A.R. Boyle, another advocate of exchange within Air Intelligence, met with the Air Member for Supply and Research General Salmond. They convinced him to support a trial exchange of publications for six months and to agree to allow technical experts from one country to visit the government research establishments of the other.[496] Salmond, however, still believed the Admiralty needed to approve of the exchange, and the Air Ministry set out to make this happen. Air Commodore John Steel, dual-hatted as Deputy Chief of the Air Staff and Director of Operations and Intelligence and who had also previously opposed exchange with the U.S, wrote to the Director of Naval Intelligence directly seeking to convince him to authorize exchange. The letter found the D.N.I. on leave at his yacht club in Lowestoft, and Steel received the predictable response that the Air Ministry would need to put the matter through the usual Admiralty process.[497]

Unable to arrange a side agreement with the Admiralty, the Air Ministry marshalled its arguments to overturn the prevailing policy on sharing technology with the United States. In October, the Air Ministry made its best case. It specifically sought the Admiralty to authorize exchange regarding aircraft carriers and torpedoes. It cited the substantial American investments in aviation technology as increasing the likelihood that the exchange would be beneficial to the British and discussed the increasing difficulty Wing Commander Christie had in fulfilling information requests. It provided responses to the most common Admiralty counter arguments that sharing with the Americans might lead to information leaks or cause other countries to request the same treatment and sought to the frame the exchange as quid pro quo on a larger

[496] Minute 86 by AMSR to DCAS, 1 August 1923, TNA: AIR 5/489.
[497] Maurice Fitzmaurice Director of Naval Intelligence, Note in reply to S.12764 to Air Commodore J.M. Steel at Air Ministry, 31 August 1923, TNA: AIR 5/489, Document 88A.

scale. It even noted that the U.S. government had "recently purchased the patents and manufacturing rights of the landing devices used" on the Royal Navy experimental aircraft carrier H.M.S. Argus, a one-off technology transfer.[498] A new officer, who was friends with the British Naval Attaché in Washington, became the Admiralty's Director of Naval Intelligence, and Christie sought to use the connection to lobby for a favorable decision.[499] The Air Ministry even prepared to bring the War Office back into the discussion.[500]

None of it worked. After a two-month delay, in early December, the Admiralty rejected the Air Ministry's entreaties. The Admiralty re-asserted its confidence in the British lead in aircraft carriers and torpedoes. It explained that H.M.S. Argus was already testing even newer equipment which would be fit to aircraft carriers under construction. In light of these improvements, the Admiralty thought the information already provided to the Americans mattered little.[501] Most importantly, the Admiralty rejected the Air Ministry's argument for a broader view of quid pro quo, writing: "It has been the Admiralty experience that the exchange of information between different countries can only readily be arranged when it relates to matters of precisely similar nature, and any attempt to exchange information on matters not of precisely similar nature leads to difficult bargaining which is liable ultimately to produce bad feelings."[502] Ironically, the Admiralty's refusal would soon generate precisely those bad feelings.

The response surprised the Air Ministry. One official noted the Admiralty seemed to have ignored part of the Air Ministry's request, and that the Admiralty's view of its own progress of

[498] J.A. Webster, Air Ministry Letter S.12764/S.6. to Admiralty, 8 October 1923, TNA: AIR 5/489, Document 91A.
[499] M.G. Christie, Letter A.A. No. 330 from Air Attache British Embassy Washington to Director of Air Intelligence, Air Ministry, 18 Oct 1923, TNA: AIR 5/489, Document 93A.
[500] Draft Letter S 12764/S6 from Air Ministry to War Office, December 1923, TNA: AIR 5/489, Document 98A.
[501] Admiralty Letter M.01159/23 to Air Ministry, 6 December 1923, TNA: AIR 5/489, Document 99A.
[502] Admiralty Letter M.01159/23 to Air Ministry, 6 December 1923, TNA: AIR 5/489, Document 99A.

aircraft carriers seemed out of step with general opinion.[503] Another thought the Admiralty must have misunderstood part of the Air Ministry's request.[504] Senior Air Ministry officials were disappointed, but decided that they could do no more than to make the Secretary of State for Air Sir Samuel Hoare aware of the Admiralty's obstinacy regarding the United States.[505]

Just after the new year, the Air Ministry notified Christie in Washington of its inability to agree to any new arrangement for sharing technology.[506] Christie, however, sought to minimize the damage by avoiding telling the Americans that he had heard anything. In the weeks after Christie learned of the Air Ministry's decision, he received requests from both the War Department and the Navy Department as to the status of their proposal.[507] He responded falsely that London was still deliberating, while also telling London that Americans were pushing the issue.[508]

This issue lay dormant until the spring 1924. Two connected events served to bring the subject back to discussion and begin the fourth and final phase of negotiations. First, the Americans began to severely limit the information they provided to the British Air Attaché in Washington, which caused Group Captain Christie to begin to take actions to gain information that the Air Ministry feared might lead him to be accused of espionage.[509] Second, the Americans

[503] Min 100 to AI by Boyle S/L, 8 Dec 1923, TNA: AIR 5/489.
[504] Min 101 to DDOI, DCAS by S. Carmichael W/Cdr, ND Dec 1923, TNA: AIR 5/489.
[505] Minute 102 to CAS by DCAS, 14 Dec 1923, TNA: AIR 5/489; Minute 103 to Secretary of State for Air by CAS, 18 Dec 1923, TNA: AIR 5/489.
[506] A.R Boyle, Air Ministry Director of Operations & Intelligence Letter S.12764/A.I.1. to British Air Attaché Washington, 3 January 1924, TNA: AIR 5/489, Document 104A.
[507] H.W.T. Eglin, Letter to M.G. Christie, 10 January 1924, TNA: AIR 5/489, Document 107A, Henry Hough, Director of Naval intelligence Letter to British Air Attaché, No date [15 January 1924], TNA: AIR 5/489, Document 108A Appendix 1.
[508] M.G. Christie, Letter I-4.Mac.1. to H.W.T. Eglin, Liaison Officer, General Staff, War Department, 11 January 1924, TNA: AIR 5/489, Document 107A; M.G. Christie, Letter A.A. No. 428 from Air Attaché British Embassy Washington to Director of Air Intelligence, Air Ministry, 17 January 1924, TNA: AIR 5/489, Document 108A.
[509] Min 109 to AI by A Boyle Squadron Leader, 1 May 1924 TNA: AIR 5/489; Message AA No. 627 "Exchange of Information, from Air Attache British Embassy Washington to Director of Air Intelligence., 20 May 1924, TNA: AIR 5/489, Document 118A.

attempted discussing the issue directly with the Air Ministry senior leadership in London.[510] This request was the first for negotiations in London rather than in Washington.

In preparation for these meetings, the Air Ministry undertook a complete review of technology exchange policy with the United States since the end of the war.[511] As part of this exchange, the Air Ministry pushed the Admiralty again. Finally, the Admiralty budged. Though no justification for their shift survives, the Admiralty agreed to permit "the exchange of information about machines as long as … information about deck-landing or anything to do with carriers" was withheld.[512] This policy essentially drew the line in the same place as the broader separation of responsibility between the Air Ministry and the Admiralty.

But just as the Admiralty finally saw fit to permit some ongoing exchange of information, a key actor within the Air Ministry reversed his position. When Air Commodore Steel, the Deputy Chief of the Air Staff asked General Salmond, the Air Member for Supply and Research, for his input in preparation for the meeting with the Americans, Salmond withdrew his support.[513] Salmond argued that he believed the American government was seeking more information from the British because they struggled to control American aviation firms. Unlike in Britain, he claimed, the American aviation firms tended to be ahead of the U.S. government in their aviation developments. Moreover, these American firms seemed willing to provide the British with information when asked.[514]

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[510] Letter from J.M. Steel to K.A. Joyce, 19 Jun 1924, TNA: AIR 5/489, Document 121A.
[511] Henry Hough, Director of Naval intelligence Letter to British Air Attache, No date [15 January 1924], TNA: AIR 5/489, Document 108A Appendix 1.
[512] Memo from D.C.A.S to A.M.S.R., 22 May 1924, TNA: AIR 5/489, Document 111A.
[513] Memo from A.M.S.R. to D.C.A.S.., 22 May 1924, TNA: AIR 5/489, Document 111A no. 2.
[514] Memo from A.M.S.R. to D.C.A.S.., 22 May 1924, TNA: AIR 5/489, Document 111A no. 2. Whether this assertion was true that American firms were willing to share their newest work directly with the British requires more research to verify.

On May 27th, Steel met with the American attachés in London, Captain Hussey and Colonel Joyce. As expected, they pressed for an immediate decision on the routine exchange of technical publications.[515] Hussey and Joyce presented the exact same offer of exchange as the Americans had originally proposed almost exactly a year before during the second phase of the negotiations.[516] The meeting left Steel concerned. He worried about the tactics Christie was needing to use in Washington and that the Americans were frustrated. He feared for the relationship with the U.S air services. He elevated the issue to the Hugh Trenchard, the Chief of the Air Staff.

Trenchard shared Steel's concerns. Fearing Christie's actions were straying into espionage, he directed that Christie cease any "activities outside the normal duties of a British Attaché."[517] Further, he wanted more detailed information on exactly what the Americans wanted to exchange information about. Trenchard favored as much exchange as possible and wanted to better understand Salmond's concerns. At this point, Trenchard knew this issue would eventually need to be raised to the Secretary of State for Air – the political leader of the Air Ministry.

Meanwhile, Steel dug more deeply into the negotiations. He arranged a follow-up meeting with the American attachés for June 30th.[518] He asked the Americans to bring sample copies of the documents they sought to exchange. He requested experts from the Air Ministry Technical Department bring copies of the British documents the American's sought, so both parties could compare the documents side-by-side.[519] The Americans repeated their frustration

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[515] Minute 113 to CAS by DCAS, 30 May 1924 TNA: AIR 5/489.
[516] Note on exchange, No Date [May-June1924], TNA: AIR 5/489, Document 112A.
[517] Min 114 to DCAS, AMSR by CAS, 30 May 1924 TNA: AIR 5/489.
[518] Min 119 to D.C.A.S by A.R. Boyle, SdrLdr, TNA: AIR 5/489; Letter from J.M. Steel to K.A. Joyce, 19 Jun 1924, TNA: AIR 5/489, Document 121A; "Notes on the Conference held in the Air Ministry with U.S.A. Attaches on the subject of the Exchange of Publications." No Date [Fall 1924], TNA: AIR 5/489, Document 124A.
[519] Min 120 to A.M.S.R by A.R Boyle, SdrLdr, 28 June 1924, TNA: AIR 5/489.

with the length of time it was taking to come a decision, and Steel tried to convince them that ongoing exchange of publications should be treated separately from the one-off exchanges of information on request. [520] After the meeting, the British experts produced an evaluation of the comparative worth of the documents.[521] In general, they found the publications comparable, though they thought the British publications more detailed. One exception stood out, as always: the Director of Research Report. The assessors believed this report contained information at least a year ahead of information available elsewhere. While they finally agreed that the Navy Material Progress Report seemed equivalent – if less detailed than the Director of Research Report – they found the suggested U.S. Army equivalent did not contain any information on research. They found it impossible to believe the U.S. Army did not have reports tracking its research. This conclusion shaped their recommendation: exchange was desirable, but only if the British could get the U.S. Army equivalent to the Director of Research Report as well as the U.S. Navy's material progress report.[522]

The Air Ministry debated what to do next for a month. It consulted with the Admiralty about the information it shared with the Americans.[523] At the end of July, the American Naval Attaché telephoned expressing his continued frustration with the delay in reaching an agreement and that the British were withholding information.[524] Steel tried to convince him of the opposite, even noting the American requests were treated "very much more sympathetically than

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[520] Notes on the Conference held in the Air Ministry with U.S.A. Attaches on the subject of the Exchange of Publications." No Date [Fall 1924], TNA: AIR 5/489, Document 124A.
[521] "Observations by Wing Commander Bowen and Major Buchanan on Proposals to Exchange Technical Information with the United States Flying Services." No Date (Summer 1924), TNA: AIR 5/489, Document 121A.
[522] "Observations by Wing Commander Bowen and Major Buchanan on Proposals to Exchange Technical Information with the United States Flying Services." No Date (Summer 1924), TNA: AIR 5/489, Document 121A.
[523] DNI to Director Air Operations and Intelligence reply to letter 3 July 1924, 18 July 1924, TNA: AIR 5/489, Document 126.
[524] Letter from DCAS TO Captain C.L. Hussey, 31 July 1924, TNA: AIR 5/489, Document 127A.

others."[525] By that point, the Air Ministry decided. It would agree to ongoing exchange of everything the Americans wanted except the Director of Research Report.[526] All that remained was to gain the Admiralty's final agreement.

On August 2nd, the Air Ministry provided a scrupulously detailed argument.[527] It laid out the details of the American proposal again. It provided an item-by-item analysis of the equivalence of the various documents. It explained that withholding Director of Research reports protected the most advanced research, especially on the wireless, torpedo, and carrier technologies about which the Admiralty had expressed concern. It stated the exchange would be re-evaluated after a year if it did not provide the expected information, and that the Americans has promised secrecy. A month later, in response to an Admiralty request, the Air Ministry provided copies of the American publications for the Admiralty to review.[528]

When the Admiralty finally responded on September 18th, they had returned to form. The Royal Navy considered "even the less important … British publications" to have technical information it did not want to share with foreign governments.[529] They stated a new standard: only information available to newspapers should be exchanged with foreign governments, unless "a definite interchange concerning some particular contrivance or matter" existed, in which case the situation should be judged on its specifics.[530]

With that response the negotiations were finally, essentially over. Hugh Trenchard requested a summary of the negotiations to provide to the Secretary of State to see if he was

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[525] Letter from DCAS TO Captain C.L. Hussey, 31 July 1924, TNA: AIR 5/489, Document 127A.
[526] Outline of Letter from S.6. to Admiralty provided by DCAS, 31 July 1924, TNA: AIR 5/489, Document 129A.
[527] Letter submitted to CAS for Admiralty, 2 August 1924, TNA: AIR 5/489, Document 132A.
[528] Min 137 to D.D.O.T. by Boyle., 21 Aug 1924, TNA: AIR 5/489; Letter from A.R. Boyle to Direct Naval Intelligence, 2 September 1924, TNA: AIR 5/489, Document 141A.
[529] Charles Walker, Admiralty Letter M.01327/241 to Air Ministry, 18 September 1924, TNA: AIR 5/489, Document 142A.
[530] Charles Walker, Admiralty Letter M.01327/241 to Air Ministry, 18 September 1924, TNA: AIR 5/489, Document 142A.

willing to take the matter to the First Lord of the Admiralty – the political head of the Royal Navy. Still, he seemed to have little expectation this escalation would make any difference. He seemed to accept that the ongoing difficulties between the British and American air services would necessarily continue because of the Admiralty's position.[531] Indeed, letters to both the American attachés in London and the British air attaché in Washington declaring the end of the negotiations were dispatched the very next day.[532]

The final collapse of two years of negotiations did not mean the end of any technology exchange between the Air Ministry and the United States, but it did end the possibility of an ongoing, automatic exchange of publications. To the extent that exchange of technical information would occur, it would only be as one-off quid pro quo requests.[533]

DV

1. Did British decisionmakers support any sharing of military related technology? If yes, what technology sharing policy did the unit support?

Yes. The Admiralty continued to support a minimal technology sharing policy of one-off transfers throughout this period. The Air Ministry shifted its position from supporting only one-off transfers to supporting ongoing exchange of some technology publications – a specified technology sharing policy — though it ultimately refused a deal because it believed the Americans were not offering all they could.

TOTT

1. What motivations, if any, did decisionmakers have to share technology?

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[531] Min 144 to DCAS by CAS, 22 Sep 1924, TNA: AIR 5/489.

[532] Air Ministry Letter S.12764 to K.A. Joyce, 25 September 1924, TNA: AIR 5/489, Document 145A; Air Ministry Letter S.12764 to C.L. Hussey, 25 September 1924, TNA: AIR 5/489, Document 145B.

[533] As an epilogue, the British Attaché in Washington began keeping detailed records of all information requested of the Americans and whether they provided a satisfactory reply. He suggested the Air Ministry do the same for American information requests in the hope that it would ensure the British could successfully argue for appropriate quid pro quos. "Official Replies Received During Month of September, Appendix (1) to A.A. No. 754, 29 Oct 1924, TNA: AIR 5/489, Document 154A Appendix (1).

No major changes in motivations occurred from the Post-War phase to the Negotiation phase. Britain and the United States still did not face a severe mutual threat, nor had the Air Ministry's situation significantly improved. The most important change was that the Air Ministry came to believe more strongly that the increasing American investments in aviation research would mean that the Air Ministry might have more to gain from freer technological exchange.[534] The value of agreeing to some form of ongoing technology sharing also increased as the Air Ministry also became increasingly concerned about the ability of its attaché in Washington to gain access to American information even through one-off requests.[535] Ironically, the Admiralty may have had reason to become less interested in foreign technology or any technology development in this period. The vast differences in the resources required to construct an aircraft versus a battleship made it inherently likely that aircraft would evolve faster than capital ships, but the Five-Power Treaty on Limitation of Naval Armament negotiated at the Washington Conference accentuated this difference. The treaty did more than just fix the relative ratio of the British, American, and Japanese fleets. Except for specifically identified vessels, it required the scrapping of all capital ships under construction. While the treaty contained provisions for replacing the ships it allowed each power to keep, it forbade replacement construction in the ten years after the treaty's negotiation.[536] In effect, the treaty all but froze capital ship technology for ten years – except for change which could be made to existing hulls. Any technological development in other domains of warfare, particularly air, could only erode the position of the

[534]Cable A.A. No. 92 from Air Attache, British Embassy, Washington to Director of Air Intelligence, 11 January 1923, TNA: AIR 5/489, Document 75A; Min 80 by D. of R. to A.M.S.R, 19 Apr 1923, TNA: AIR 5/489.
[535] M.G. Christie, Letter A.A. No. 280 from Air Attache British Embassy Washington to Director of Air Intelligence, Air Ministry, 28 May 1923, TNA: AIR 5/489, Document 85A; J.A. Webster, Air Ministry Letter S.12764/S.6. to Admiralty, 8 October 1923, TNA: AIR 5/489, Document 91A.
[536] Department of State, "Limitation of Naval Armament (Five-Power Treaty or Washington Treaty)," February 6, 1922, Library of Congress, https://www.loc.gov/law/help/us-treaties/bevans/m-ust000002-0351.pdf.

Admiralty's ships. Since the Admiralty had lost control of the naval air service to the Air Ministry, it had nothing to gain from aviation developments.

2. How did sharing state decisionmakers assess future interest alignment with the potential recipient state?

In general, Britain continued to perceive its interests would stay aligned with the United States. The most important change in the relationship was the conclusion of the Washington Treaty on Limitation of Naval Armament, which was approved by the Senate on March 29, 1922. This agreement ended the chance that a naval arms race could upset relations between the two countries. That the Washington Conference also brought an end to the Anglo-Japanese Alliance which further reduced Anglo-American tensions. Indeed, in his arguing for ongoing exchange of military aviation information with the United States, one Air Intelligence official wrote, "There is no prospective danger of America becoming an enemy in fact there seems many reasons for endeavoring to co-operate with her."[537]

3. Did the decisionmakers express concerns about the ability of the recipient state to protect technological secrets?

For the Air Ministry, this concern had lessened. Without a doubt, the Air Ministry still believed that the Americans were less effective at protecting information, but they came to down weight this concern for the two reasons. First, American officials promised in writing that they would not allow British information to reach the press without prior British approval.[538] The Air Ministry trusted this promise.[539] Second, with this guarantee protecting them, the British became

[537] A.R. Boyle, Memorandum on Exchange of Information, No Date [Jan-April 1923], TNA: AIR 5/489, Document 76A.
[538] W.K. Naylor and L. McNamee, Joint War Department Navy Department Letter No. Op-16-A NWH:ALH to Colonel Christie, 24 May 1923, TNA: AIR 5/489, Document 85B.
[539] Air Ministry Letter S.12764 to Maurice Fitzmaurice, Director of Naval Intelligence, Admiralty, 27 August 1923, TNA: AIR 5/489, Document 87A.

willing to say they would end any ongoing sharing if their material appeared in the American press.[540] As a result, the Air Ministry became less concerned about American leaks. It is unclear if the Admiralty still had this concern. While the Admiralty continued to oppose sharing with the Americans on any more than a quid pro quo basis, it no longer cited a specific concern that Americans would be unable to protect British information.

Thus, in the period after the Washington Conference, the Air Ministry became more inclined to share technology more liberally with the Americans as part of an ongoing exchange on information. In the end, however, continued Admiralty opposition as well as the Air Ministry's belief that the U.S. Army was withholding its most advanced research information led the negotiations to fail. The Air Ministry's increased willingness to share information coincides with a reduction in a source of potential future conflict and with American guarantees of information security, both are factors TOTT predicts to affect technology sharing.

Single-Period Structural Realism & Technological Capability

This explanation expects current mutual threats to be the major motivator of technology sharing. As in the previous period, Britain and the United States did not face any major mutual threats during this period, so this explanation would predict no technology sharing. Because no major inputs to this theory changed in this period, it does not offer any insight into why attempts at more liberal technology sharing occurred in this period.

Economic

The economic alternative explanation suggests that states share technology to maximize their economic gain and will withhold technology to preserve their competitiveness.

1. Did the sharing arrangement involve monetary payments to a sharing state?

[540] A.R. Boyle, Memorandum on Exchange of Information, No Date [Jan-April 1923], TNA: AIR 5/489, Document 76A.

No. Monetary payments did not occur as part of the sharing in this period.

2. Did leaders cite economic benefits as an important rationale or haggle over them?

No. Economic considerations did not feature in the sharing negotiations.

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

No. Concerns over competitiveness did not appear to affect sharing in this period.

Given the lack of economic factors discussed during this period, this explanation would expect both the Air Ministry and Admiralty to prefer a technology sharing policy of "none".

Organizational

1. What was the role of military organizations in shaping the sharing decision?

   Substantial. The service ministries, particularly the Air Ministry and Admiralty, dominated these discussions. Senior uniformed leaders continued to avoid taking technology sharing issues to the level of their department's civilian leadership. To the extent that their decisions about technology sharing faced constraints, the other service ministries imposed them.

2. If military organizations were involved in the decision, were those armed forces operating in close quarters with the potential recipient state's armed forces?

No. The British and American armed forces were not conducting any combined operations during this period.

3. What was the role of scientific organizations in shaping the sharing decision?

None. As in the Post-War phase, independent scientific organizations played no role in these discussions. Within the Air Ministry, the research and supply divisions generally opposed technology sharing without quid pro quo or wanted restrictions on it.[541] When they offered to take a chance on technology sharing, they had low expectations for what they would receive in return.[542]

Because military and naval organizations have SOPs that prioritize secrecy – especially in peacetime – and because these organizations led the British technology sharing negotiations, the organizational explanation would predict either a minimal technology sharing policy or no technology sharing for both the Air Ministry and the Admiralty. This theory accurately predicts the Admiralty's preferences, but it does not explain why the Air Ministry came to prefer specified technology sharing policy in this period.

That said, organizational interests and bureaucratic politics may provide insight into the varying responses of the Air Ministry departments. The Air Attaché in Washington and Air Intelligence staffers provided the strongest support for ongoing technical exchange. These officials had the most direct contact with American technology and had the most to gain professionally from successful exchange. On the other hand, hesitance or outright opposition often came from the Air Ministry's research departments, the offices that had the most to lose. Not only could American research potentially show that British research was falling behind, but the Research Departments may not even have had the manpower to assimilate and act on what the Americans provided. The Air Ministry's research apparatus was drastically scaled back due to post-war funding cuts.[543] At one point, the Director of Research did not think he could even spare personnel to clip secret portions out of Air Ministry research reports before sending them

[541] A.R. Boyle, Letter to Wing Commander Christie, 18 August 1922, TNA: AIR 5/489, Document 72B; Min 81 by AMSR to DCAS, 24 Apr 1923, TNA: AIR 5/489; Min 80 by D. of R. to A.M.S.R, 19 Apr 1923, TNA: AIR 5/489, Min 86 by AMSR to DCAS, 1 August 1923, TNA: AIR 5/489.
[542] Min 80 by D. of R. to A.M.S.R, 19 Apr 1923, TNA: AIR 5/489.
[543] Rood, "The Royal Aircraft Establishment Farnborough," 58.

to the Americans.[544] That the Air Attaché was far from headquarters likely hampered the effectiveness of his arguments. Senior officials likely did read his technical reports, but he made the most progress when he returned to London. The reality that the Director of Research and his staff would inevitably be the arbiters of what research was most useful also strengthened their position.

A final organizational dynamic that requires explanation is the Air Ministry's continual deference towards the Admiralty in coordinating sharing policy. This deference is particularly surprising given the Air Ministry's active disregard for much stronger Admiralty preferences regarding the Sempill Mission during the same period. Several factors likely contribute. First, the Air Ministry likely wanted to pick its battles with the Admiralty carefully. The Air Ministry was fighting for its life during this period and could not "die on every hill." Second, the Air Ministry was far more likely to get caught without a plausible excuse engaging in ongoing technological exchange with the United States than was its Sempill Mission gimmick. The Foreign Office staff at the Embassy in Washington and in London had thought it important that all the services pursue similar technology sharing policies. Had the Air Ministry gone its own way, it is likely it would have been caught. Because the United States did not have an independent air force, the British Air Attaché in Washington worked with the U.S. War and Navy Departments. These Departments also worked with the British Military and Naval attachés. The Americans, expecting similar treatment, may have unintentionally ratted out the Air Ministry to the British Embassy if the Embassy staff had not figured out what was going on first. In the Sempill case, the mission was independent of the Embassy and nominally "unofficial." Finally, compared to the Sempill Mission, which held the promise of securing aircraft sales to help keep the British

[544] Min 80 by D. of R. to A.M.S.R, 19 Apr 1923, TNA: AIR 5/489.

aviation industry afloat when it was in dire straits, the Air Ministry never thought the benefits of ongoing technological exchange with the Americans were more than marginal. Even if had the Admiralty approved of ongoing sharing, Air Ministry officials did not think what the Americans offered was worth their Director of Research Report. In summary, the Air Ministry faced choices in the bureaucratic battles it would fight, and in the case of technological sharing with the Americans, going its own way was perceived to yield marginal benefits with a high risk of getting caught.

Table 4-3: Theory Predictions and Actual Values for Technology Sharing during The Negotiation

	TOTT	Structural Realism	Economic	Organizational	Actual Desired	Actual Observed
Air Ministry	Minimal	None	None	None/Minimal	Specified	Minimal
Admiralty	Minimal	None	None	None/Minimal	Minimal	Minimal

Conclusion

Once Britain and France recognized that the First World War would be a long conflict, they began sharing technological research with each other. When the United States joined them in the war against Germany, both Britain and France immediately expanded their technology sharing to the United States and provided full access to their most up to date weapons and research. When the war ended, Britain slowly began to scale back this sharing. Within a year of the end of the war, Britain had a minimal technology sharing policy toward the United States under which it would only share technology information as part of a one-off quid pro quo. This policy was consistent across the British armed services. In the summer of 1922, the American Navy Department proposed a resumption of ongoing naval aviation technology exchange with the Air Ministry. Two and a half years of negotiations ensued. Though these negotiations ultimately failed, the British Air Ministry was far more inclined to share in this period than it had been previously.

Table 4-4***Error! Reference source not found.*** shows the predicted values for technology sharing policy for TOTT and the alternative explanations, as well as the actual observed values. TOTT, Structural Realism, and Organizational explanations all explain the technology sharing that took place during the First World War. Economic explanations do not. Structural Realism and Organizational explanations predict more restricted technology sharing after the war than occurred, though these theories provide less specific predictions, and so cannot be discounted. TOTT provides slightly better predictions for the Post-War and Negotiation periods and provides some explanations for the Air Ministry's increased willingness to consider a policy of specified sharing during the Negotiation.

Table 4-4: Theory Predictions and Actual Values for Anglo-American Technology Sharing during and after the First World War

<table>
<tr><th></th><th>TOTT</th><th>Structural Realism</th><th>Economic</th><th>Organizational</th><th>Actual Desired</th><th>Actual Observed</th></tr>
<tr><td>WWI</td><td>Open</td><td>Share</td><td>None</td><td>Share</td><td>Open</td><td>Open</td></tr>
<tr><td>Post-War, Air Ministry</td><td>Minimal</td><td>None</td><td>None/Share</td><td>None/Minimal</td><td>Minimal</td><td rowspan="2">Minimal</td></tr>
<tr><td>Post-War, Admiralty</td><td>Minimal</td><td>None</td><td>None</td><td>None/Minimal</td><td>Minimal</td></tr>
<tr><td>The Negotiation, Air Ministry</td><td>Minimal</td><td>None</td><td>None</td><td>None/Minimal</td><td>Specified</td><td rowspan="2">Minimal</td></tr>
<tr><td>The Negotiation, Admiralty</td><td>Minimal</td><td>None</td><td>None</td><td>None/Minimal</td><td>Minimal</td></tr>
</table>

In the end, as the evidence suggests, the lack of ongoing technology sharing between the British and the United States after the First World War was overdetermined. Military and Naval SOPs that favored secrecy; bureaucratic competition and prestige; economic competition; the possibility that other states intentions can change; and asymmetric information problems all interacted to block ongoing technology sharing. Even when one or two of these barriers disappeared, the others often remained. As a result, a minimal technology sharing policy, which featured case by case authorizations to transfer bits of technology or research, allowed technology sharing to occur only when the stars aligned.

Chapter 5
Anglo-American Exchange, 1937-1941

After the failure of negotiations for ongoing technology exchange between Britain and the United States in the mid-1920s, little further technology sharing occurred between the two powers. As the geopolitical climate worsened in the late 1930s, both states developed a renewed interest in technology sharing but only achieved minor successes. At first, the start of the Second World War featured more continuity than change in technology sharing between the British and Americans. The dynamic changed with the German invasion of France. As the Allied armies buckled, the British became highly interested in sharing technology with the United States. This interest eventually produced the British Technical Mission led by Henry Tizard, often known by his name. The Tizard Mission provided the United States Britain's most secrets technologies and convinced the Americans to reveal their own. It established ongoing scientific sharing between the two countries which would last until the end of the war. The fruits of that collaboration – radar, improved sonar, penicillin, the atomic bomb, and more – significantly affected the war. This chapter tests TOTT and its competing alternative explanations against the growth of British technology sharing in the late 1930s through the Tizard Mission and its immediate aftermath in late 1940 and early 1941. It follows both the argument in the British government over technical disclosure with the United States and the actual technology sharing policy during this period and finds that, consistent with TOTT, the most important factors in shaping the British decision were the rapidly increasing threat environment, British perceptions of American security practices, and the belief that the United States would be a future threat to British interests. Almost day by day as the situation on the continent worsened, the British became more willing to share technology with the United States.

Because of the outsize impact it had on scientific research during the Second World War and, as a result the course of the war itself, the Tizard Mission and the negotiations between the United States and Great Britain in the years preceding it have spawned multiple histories. Besides developing a critical record of these negotiations, historians have focused much of their scholarship on two points. First, they have universally highlighted the dramatic shift in British policy from attempted "quid pro quo" negotiation for specific technology exchanges to the unique and unselfish decision to provide Britain's technological crown jewels to the United States without demanding anything in return.[545] They have disagreed over the extent to which this choice should been seen as a (somewhat desperate) tactic to gain access to the Norden Bombsight or as a broader play to increase American goodwill or to get access to American research more broadly and to the American industrial base.[546] Second, they have debated who was responsible for the idea of the mission and abandoning quid pro quo exchange. Three possibilities exist: the Churchill Government, the British scientific community (especially Henry Tizard), or the ministerial bureaucracy of the British Government.[547]

While the second of these questions is less important to assessing TOTT, addressing the first is critical to understanding the motivations of the various decisionmakers in supporting or opposing the mission. While previous histories have focused on the extent to which the mission

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[545] Ronald Clark, *Tizard.*, *Tizard / Ronald W. Clark.* (Cambridge, MA: MIT Press, 1965), 248, https://lib.mit.edu/record/cat00916a/mit.000157971; Zimmerman, *Top Secret Exchange*, 4; Stephen Phelps, *The Tizard Mission: The Top-Secret Operation That Changed the Course of World War II.* (Yardly, PA: Westholme, 2010). p. xi.

[546] Clark avoids discussing specific motivations for the mission except in the broadest terms. Zimmerman sees the motivation for the mission as a direct continuation of earlier British attempts to gain the Norden Bombsight and more broadly as a way to initiate scientific exchange and restore trust in the Anglo-American relationship. Phelps saw the mission as an attempt to bring the United States into the war and gain access to American industrial capacity. Clark, *Tizard.*, 249; Zimmerman, *Top Secret Exchange*, 4–6; Phelps, *The Tizard Mission*. p. xii.

[547] Clark successfully shows that the idea for the mission did not originate with the Churchill Government as had been previously believed and gives scientists the principal credit. Zimmerman acknowledges the critical role scientists played but places them in the context of an already ongoing effort by multiple British ministries to exchange information with the United States that was moving away from the unsuccessfully quid pro quo model. Clark, *Tizard.*, 249; Zimmerman, *Top Secret Exchange*, 4.

should be seen as an effort to gain access to American technologies (specific or otherwise), they have performed surprisingly little analysis of the various reasons British policymakers cited for their decision to pursue the mission. For the first time, this chapter identifies seven distinct though interrelated arguments British decisionmakers made at various times in support of the mission. Getting direct access to existing U.S. technology – that is, initiating technological exchange – was welcome but much less important than generally understood. As the British themselves understood, though the mission was not without risk, they stood to – and did – gain substantially from the Tizard Mission's sharing of technology even if the Americans had declined to reveal many of their secrets.

In the reminder of the chapter, I discuss the conversations between Britain and the United States about technology sharing in the late 1930s and decisions leading to the Tizard Mission, which initiated open technology sharing between these states. After briefly confirming that this case meets TOTTs scope conditions I recount and analyze the developments in British technology sharing through three phases. The first, "Pre-War," phase began in 1937 with the initiation of staff talks between the U.S. and British Royal Navies. As the threat of war in the Far East and then in Europe increased, the United States and Britain became interested in security collaboration and potentially trading advanced technology with one another. They were, however, only able to complete limited technology exchanges, always on a quid pro quo basis, and only after substantial negotiations. The difficulty of these exchanges and the feeling by the British that they had gotten the worst of them worked to undermine trust between the United States and Britain.

The second phase – "Failure of Appeasement and the Phony War" – began in Spring 1939 with the recognition that war was likely imminent and continues through the invasion of

France in May 1940. In many ways this period exhibited continuity with the previous period. Though Britain declared war on Germany, it was not yet under extraordinary pressure. The feared air raids did not materialize in any significant manner. The advent of war did lead to a renewed effort to attempt technology exchange with the United States, but except for amongst some scientists, attempts at sharing were still one-off quid pro quos. Still, this period did see the initiation of the Hill Mission to better assess the status of American technology, but only the Air Ministry was willing to seriously consider a more permissive technological exchange.

The final phase – "Blitzkrieg and After" – began with the invasion of France and goes through the end of the period under study. It witnessed a rapid change in the willingness of the various organs of the British government to support more open technology sharing with the United States. Almost directly as the Allied military position worsened and the seriousness of the threat to Britain increased, more ministries and officials within the British government came to support sharing technology with the United States. Winston Churchill himself proved the major exception to this trend, but though it took him longer to approve the mission and he briefly hesitated, eventually he came to support the mission as well.

Scope Conditions

1. Was the technology sharing that occurred, or was under consideration, government-to-government?

Yes. The entire set of negotiations discussed in this case as well as the technology sharing that occurred because of it took place between official representatives of the British and American governments.

2. Was the technology that occurred or was under consideration deliberate (i.e. the technology transfer was known to be a likely outcome of the activity under consideration)?

Yes. The explicit purpose the negotiations covered in this case and the British Technical Mission, when it occurred, were to share technology.

3. Did the technology transfer involve transferring the capability to produce weapons or other items without further support from the sharing state?

Yes. When the British Technical Mission arrived in the United States it transferred or arranged to have transferred diagrams and samples of British technology to the United States. These technologies included, but were not limited to, the cavity magnetron, micropup electronic valves, a complete A.S.V. radar, an aircraft fitted with A.I. radar, aircraft turrets, and the Kerrison Predictor (for anti-aircraft guns).[548] In some cases, the British Technical Mission transferred this information directly to American firms who would produce it. The Mission also assisted the American National Defense Research Committee (NDRC) in placing orders with American firms for British technology that the Mission had provided for research use in NDRC labs.[549]

Moreover, technology transfer for production in the United States was a key motivation for the discussion. A.V. Hill and Lord Lothian made the argument for American production of British technology in their initial message that opened the debate that led to the Tizard Mission.[550] This line of argument continued throughout discussion of the mission including after

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[548] For AI, Electronic components, and involvement of commercial firms, see, for example, E.G. Bowen, "Meeting of Microwave Sub-Committee of N.D.R.C.," New York, 14 October 1940, TNA: AVIA 10/1 Document 78; R.H. Fowler, "Report on a Visit to Dr. A.L. Loomis' Laboratory at Tuxedo Park," 3 November 1940, TNA: AVIA 10/2 Document 105. For turrets, see British Technical Mission, Minutes of Daily Meeting, 12 September 1940, TNA: AVIA 10/4. and Ministry of Aircraft Production, Telegram MAP 1114 to Henry Self, 17 October 1940, TNA: AVIA 38/465. For ASV, see E.G Bowen, "Progress Report of ASV Production in Canada & USA for period ending January 10th, 1941," 11 January 1941, TNA: AVIA 10/3, Document 229. For Kerrison Predictor, see "Statement regarding practice hitherto followed by Departments in regard to the disclosure to the U.S.A. of secret information relating to supply matters," No date [13 December 1940], TNA: AVIA 38/47.

[549] J.D. Cockcroft, Letter to C.S. Wright, Director of Scientific Research Admiralty, 4 November 1940, TNA: AVIA 7/2796; E.G. Bowen, "Report 9.1: Report on American Version of British Pulse Values for Period Ending Feb. 10th. 1941," 11 February 1941, TNA: AVIA 10/3, Document 256

[550] Lord Lothian (Washington), Telegram No. 595 to Foreign Office, 23 April 1940, TNA: Premier 3/475/1, p. 35

Churchill began questioning the mission on July 17th, when General Ismay argued that enabling the Americans to incorporate British technical secrets into the equipment they would manufacture for the British was the strongest argument the Air Ministry had made for the mission.[551]

Rekindling British and American Technology Sharing in the late 1930s

Surprisingly, given the attitudes presented in the preceding chapters, renewed efforts at Anglo-American technology sharing began between the U.S. Navy Department and the British Admiralty. As the 1930s progressed, Fascist and Nazi government rose in Europe, Japan became more aggressive in Asia, and the Americans and British began to consider greater coordination. In early 1936, U.S. and British delegations discussed the possibility of exchanging technical information in conjunction with the negotiations for the Second London Naval Treaty. The negotiators had contemplated combined naval operations, which technological exchange might have facilitated, but in the end, the Admiralty refused.[552]

As the British Foreign Office and Admiralty analysts of 1920-1 might have predicted, it was Japanese actions that initially pushed the British and Americans closer. In July 1937, the Japanese renewed their war in China and quickly captured Beijing, Shanghai, and Nanjing. In December, Japanese aircraft attacked the *USS Panay* on the Yangtze River. The United States and Great Britain decided to coordinate their activities in the event of a wider war in the Far East. On the last day of 1937, Captain Royall Ingersoll, the Director of the U.S. Navy's War Plans Division and future Commander of the U.S. Atlantic Fleet, arrived in London for staff talks

[551] H.L. Ismay, Minute to Prime Minister, 18 July 1940, TNA: Premier 3/475/1, p. 32
[552] Zimmerman, *Top Secret Exchange*, 27.

with British Captain T.S.V. Phillips.[553] As a direct result of these talks, the American naval attaché in London asked the Admiralty to restart technical exchange and suggested a series of topics including communications equipment, damage control procedures, boom-defense equipment, and minesweeping.[554] In May, the Admiralty agreed in principle to a limited exchange of information with the Americans on the basis of quid pro quo.[555] The arrangement had to remain informal because of the American neutrality acts. On May 25th, the British provided the U.S. naval attaché in London full technical drawings and specifications for their destroyer minesweeping gear. The Americans provided similar information on their own minesweeping equipment and allowed the British naval attaché in Washington to visit U.S. ships carrying experimental mine-sweep gear.[556]

Despite this auspicious start, problems soon developed. Captain Russell Wilson, the American naval attaché in London suggested exchanging tactics – a separate issue from the previously discussed strategic coordination and technological exchange – and offered naval aviation technical information to sweeten the deal. The offer fell flat.[557] The Admiralty thought it would be difficult to keep the discussion limited to tactical details it was willing to share. Both sides had difficulties assessing the value of the information the other side proposed to share, because they did not know how that information compared to their own. Both navies tended to assume they were more technologically advanced than the other and so had little to gain from exchange.[558] In September, the British naval attaché in Washington, after having visited the American minesweepers, reported that the American technology was of much less value than

[553] Zimmerman, 27.
[554] Zimmerman, 28.
[555] Phelps, *The Tizard Mission*, 57.
[556] Zimmerman, *Top Secret Exchange*, 31.
[557] Zimmerman, 31.
[558] Phelps, *The Tizard Mission*, 57.

what the British had provided the Americans.[559] By December the British Naval intelligence believed the U.S. Navy was abusing its privileged access to British information – gaining more than it was giving.[560]

One more exchange would occur, but it took more than a year of painful negotiations. The British offered information on boom defense technology. Because the Americans had nothing similar, the British made three proposals for other technology they would like in return before they could make a deal. Finally, the Americans agreed to provide information on aircraft carrier landing equipment. Not until late March 1939 – after a new U.S. naval attaché Captain Alan Kirk arrived in London – did the exchange occur.[561] Soon thereafter Alfred Duff Cooper, the First Lord of the Admiralty, and Lord Chatfield, the First Sea Lord, both of whom had strongly supported coordination with the Americans left their positions. The loss of advocates for exchange in the senior civilian and uniformed positions in the Admiralty only made exchange more difficult. Only a few further and largely insignificant quid pro quo exchanges occurred.[562]

Shortly after this sputtering attempt at naval technology exchange, the Air Ministry began seeking American technology as well. As war became more likely in the late 1930s, Britain and France both accelerated their rearmament. As part of these programs, both sought to purchase aircraft in the United States. In 1938, the first British Purchasing Commission was established in the United States for this purpose and began placing aircraft orders.[563] In general, like officials at the Admiralty, Air Ministry officials who visited the United States believed British technology remained superior. One exception stood out. The Air Ministry wanted the Norden Bombsight.

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[559] Zimmerman, *Top Secret Exchange*, 31.
[560] Zimmerman, 32.
[561] Zimmerman, 32.
[562] Zimmerman, 33.
[563] R.A.L Smith, "Anglo-American Relations on Questions Affecting Aircraft Production and Aeronautical Research," 10 September 1942, TNA: AVIA 38/237, p. 1.

Developed for the U.S. Navy, the Norden Mark XV bombsight was unlike anything else in existence. It combined a gyrostabilized telescope with an analogue computer and autopilot function that greatly improved bombing accuracy in pre-war tests. At a time when air forces and politicians believed that bombers were likely to be war determining weapons, it appeared the sight could provide a major advantage. In early 1938, the Air Ministry asked to buy the Norden from the U.S. Navy. It refused. In June, the head of the British Bomber Command demanded the Air Ministry continue its attempts. In August, A.R. Boyle – who had advocated for exchange with the Americans in the 1920s and was now the civilian deputy head of Air Ministry intelligence – asked the air attaché in Washington Air Commodore Pirie to request the Norden from the U.S. Army. The Army was often more helpful than the Navy. Pirie reported that he had already asked and learned that because the Navy had developed the bombsight, it controlled its release. Attempts to gain the sight stalled.[564]

In January 1939, the likelihood of any exchange worsened. On January 23rd, a Douglas Aircraft Company bomber crashed during a test flight near Los Angeles. The pilot and flight engineer died, but one passenger survived. Despite attempts to hide his identity, the press soon reported that he was Captain Paul Chemidlin of the French Air Force. A month-long scandal developed in Congress amongst members committed to neutrality.[565] President Franklin Roosevelt promised not to sell secret technology to any country.[566]

Boyle, with limited awareness of what had happened, pushed Pirie to attempt to gain the bombsight again in early March. Boyle authorized Pirie to trade information on British bombsights as well as power-driven aircraft gun turrets and machine gun improvements in

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[564] Zimmerman, *Top Secret Exchange*, 35–36.
[565] Phelps, *The Tizard Mission*, 59.
[566] Zimmerman, *Top Secret Exchange*, 36.

exchange for the Norden. Though Pirie was pessimistic, he tried every approach he could. Even as new demonstrations made the British even more anxious to have the Norden, Pirie got nowhere.[567]

DV

1. Did the British support any sharing of military related technology? If yes, what technology sharing policy did the unit support?

Yes. In the area of technology sharing, the major development of the late 1930s was the increased interest on both sides of the Atlantic in Anglo-American technology sharing, but especially between the two navies.

This change occurred first in the British Admiralty (and to some extent the U.S. Navy) with the development of staff talks in late 1937 that then produced technology exchange negotiations. While the inter-war policy had always been that the British and American navies were willing to exchange technical information on a quid pro quo basis, no significant exchanges or negotiations had occurred since the early 1920s. Thus, the ongoing technology sharing negotiations that began in late 1937 and resulted in two quid pro quo technology exchanges – (1) a reciprocal exchange of minesweeping equipment and (2) British boom defense gear for American carrier landing systems – marked an important change. Because both exchanges were subject to individual negotiations, they constitute examples of a minimal technology sharing policy.

The Air Ministry began to have an interest in gaining American technology and sharing its technology with the United States during this period, but it was not willing to offer its own technology in exchange. Though the British Air Ministry generally thought its technology was

[567] Zimmerman, 38.

superior to that of the United States, it sought to gain access to the Norden bombsight beginning in 1938. Thus, while the Air Ministry became more interested in American technology, its technology sharing policy was still None.

TOTT

1. What motivations, if any, did decisionmakers have to share technology? Did the sharing state face a severe and immediate threat that it shared with the potential recipient state?

In both the case of the British Admiralty and Air Ministry, the worsening geo-political climate stimulated renewed interest and willingness to engage in technology sharing with the United States. As multiple historians have argued, British and American coordination and relations more broadly improved in the late 1930s in large part due to the worsening security situation, first in the Far East.[568] Both countries harbored concerns about Japanese expansionism. By the late 1930s Britain and the United States engaged in substantial intelligence sharing on Japanese capabilities, particularly air power.[569] The initial resumption of negotiations over technology sharing grew out of naval staff talks between the U.S. and British Royal navies to coordinate their dispositions in the event of a larger war in the Pacific. Additionally, the Far Eastern threat was of greater concern to the Admiralty than the Air Ministry. While air power was expected to play a major role, in part substituting for air and ground forces, in any conflict with Japan the theater remained owned by the Navy. Additionally, the RAF's founders and officers saw defending Great Britain from strategic bombing and engaging in strategic bombing

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[568] Greg Kennedy, "Simpson, M. (Ed.) (2010). Anglo-American Naval Relations, 1919–1939," *Diplomacy & Statecraft* 23, no. 4 (December 1, 2012): 775–76, https://doi.org/10.1080/09592296.2012.720193; Christopher M. Bell, "Book Review: Anglo-American Naval Relations, 1919–1939 Edited by Michael Simpson," *War in History* 19, no. 1 (January 1, 2012): 106–7, https://doi.org/10.1177/0968344511422316d.

[569] Greg Kennedy, "Anglo-American Strategic Relations and Intelligence Assessments of Japanese Air Power 1934-1941," *Journal of Military History* 74, no. 3 (July 2010): 749.

against adversaries as key missions.[570] Neither of these missions would play an important role in a Far East war. Japan was too far from Great Britain to pose a strategic bombing threat to the home island, and the Japanese home islands were too far from any British air bases for the Royal Air Force to threaten them with bombing, at least early in any potential war. Thus, it is unsurprising that the potential for a war with Japan motivated the Admiralty more than the Air Ministry.

2. How did sharing state decisionmakers assess future interest alignment with the potential recipient state?

The British did not perceive the United States as a security threat. While views of interest alignment varied by region, even in the cases where the British saw their security interests most dissimilar to those of the United States, they were still not seen in opposition. Though tension existed at times in the relationship, war between the two states was generally viewed as unthinkable.

A July 1938 report from the Head of the Foreign Office's Economic Relation Section illustrates.[571] The Foreign Secretary viewed the assessment of sufficient quality that he forwarded it to the entire cabinet. F. Ashton-Gwatkin had just returned from six weeks in the United States. While most of his report assessed the state of the American economy and its effects on domestic politics, he concluded with a general discussion of Anglo-American relations. While Ashton-Gwatkin acknowledged that "suspicion and hesitation" existed "on both sides," he assessed the American public as concerned over the threat to democracy posed by dictatorships in Europe and Japan. He thought that were a war to occur in Europe, the American public would be much more

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[570] Overy, *The Birth of the RAF, 1918*. p. xi.
[571] F. Ashton-Gwatkin, "Economic Situation in the United States of America in May 1938," 7 July 1938, TNA: CAB 24/227/42.

opposed to Germany than it had been in 1914. Ashton-Gwatkin did not think this sentiment would immediately align the United States with Britain, but he thought the United States would display "pacific benevolence" and might eventually join the war if it dragged on.[572]

This assessment matches that of historians. In surveying the scholarship of Anglo-American relations, David Reynolds recognizes that the British went out of their way to avoid antagonizing the United States during the late 1930s even if some British officials opposed this approach.[573] Similarly, he assesses that while British officials could never rely on American support and there was "suspicion and estrangement," the concern was about a lack of support rather than the risk of war.[574] Richie Ovendale concludes that at least on a diplomatic level the "special relationship" already existed in 1938.[575] During the Munich Crisis, FDR even told the British Ambassador in Washington the circumstances (circumscribed though they were) in which FDR could see the United States entering a war against Germany in support of Britain.[576] Even then, relations improved with the threats of 1939. To the British, America was not likely to become a threat.

3. Did the decisionmakers express concerns about the ability of the recipient state to protect technological secrets?

Though British decisionmakers did not directly express concerns about American security, they likely had them. During this period, British decisionmakers had a general hesitance to provide any technology to the United States unless they received something in return, but I

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572 F. Ashton-Gwatkin, "Economic Situation in the United States of America in May 1938," 7 July 1938, TNA: CAB 24/227/42 p. 374.
573 David Reynolds, "Rethinking Anglo-American Relations," *International Affairs (Royal Institute of International Affairs 1944-)* 65, no. 1 (December 1, 1988): 95, https://doi.org/10.2307/2620984.
574 Reynolds, 105.
575 Ritchie Ovendale, "Rapprochement," in *Anglo-American Relations in the Twentieth Century*, ed. Ritchie Ovendale, British History in Perspective (London: Macmillan Education UK, 1998), 27, https://doi.org/10.1007/978-1-349-26992-1_1.
576 Ovendale, 33.

have not yet found evidence where they specifically cite concerns with American security. American counterintelligence had long had a poor reputation in Europe.[577] Later, however, the British would fear lax American security because of earlier experience, so it is likely this consideration affected their decisions in this time too. Indeed, not only did the Germans have significant espionage activities during this period, but some also made big news.

The Germans had created several spy rings in the United States during the 1930s. These spies prioritized stealing American technology, especially aircraft technology. The Germans successfully stole plans from several aircraft firms including Curtiss, Sikorsky, Vought, Boeing, and Douglas as well as the plans for destroyers and anti-aircraft guns.[578] In 1938, the British tipped the Americans off to one German spy ring which had been passing its correspondence through an address in Scotland.[579] Acting on the tip, the FBI unraveled the ring. They were the first Nazi spies caught in America. The story of the spy ring, codenamed Crown, and the ensuring espionage trial of Guenther Rumrich and his associates became major news in 1938. The New York Times ran 50 stories about it in 1938 including 15 on the front page. Both the help the British provided the Americans in identifying the spy ring and publicity this story received make it highly likely British decisionmakers were aware of German technical espionage in the United States. The fact that Americans had needed British help to identify the ring was unlikely to increase British confidence in U.S. counterintelligence. Thus, while there is no

[577] The previous chapter discussed British concerns about the inability of the United States to keep developments of military technology from the press. The Germans too had since American counterintelligence as poor throughout the interwar period. Ladislas Farago, *The Game of the Foxes: The Untold Story of German Espionage in the United States and Great Britain During World War II* (New York: David McKay and Company, 1972), 456.
[578] Joan Irene Miller, "Spies in America: German Espionage in the United States, 1935-1945" (Masters, Portland, Oregon, Portland State University, 1984), 24–25, https://doi.org/10.15760/etd.5463.
[579] Miller, 23.

"smoking gun" that the concerns about U.S. security shaped British decision making in this period, it is likely that it did.

To sum up, there was a low-level but growing threat to British interests from Japan and Germany, but there were no severe threats either to British national or organizational interests. The British were not concerned about the Americans as a future threat, but they likely had concerns about American security. Give these conditions, TOTT would predict that both the Admiralty and Air Ministry would have pursued technology sharing policies of "none."

Single-Period Structural Realism & Technological Capability

This theory expects that states should share technology with potential allies in response to international threats if the potential receiving state has the technical capability to assimilate the technology. In this period the potential threats to both the United States and Britain increased, especially from Japan. Because the Royal Navy retained primary responsibility for defending British interests in the Far East, this threat should have affected its calculations more than those of the Royal Air Force. Still, while the threat was increasing it was not high. This theory does not provide precise technology sharing policy predictions, especially with such a low-level threat. Still, given the situation and division of responsibilities between the ministries, this theory would most likely predict a preferred technology sharing policy of "none" for the Air Ministry. Whether the threat would have been sufficient to motivate the Admiralty to share technology is ambiguous. Because the United States was highly technologically advanced, the British should not have withheld any technology for technology capability reasons. These predictions are roughly in line with what occurred.

Economic

The economic alternative explanation holds that states should share technology when they will gain economic benefits from the sharing and stop technology sharing when the sharing would make them less economically competitive. This approach cannot explain why Britain chose to begin sharing technology with the United States in this period.

1. Did the sharing arrangement involve monetary payments to a sharing state?

No. No monetary exchange from the United States to Britain occurred as part of any technology sharing in this case. Though the British offered to buy the Norden bombsight from the United States, the United States refused.

2. Did leaders cite economic benefits as an important rationale or haggle over them?

No. Because neither Britain nor the United States seriously discussed or considered other economic payments as a motivation for sharing. No such haggling occurred.

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

No. British leaders did not discuss the potential of future economic competition with the United States when considering technology sharing during this period, though this may have been because the technological discussions under consideration were rather small.

Overall, there do not appear to have been economic motivations for sharing technology in this period, nor do economic concerns appear to have created major barriers. For both the Admiralty and the Air Ministry this theory would prediction no technology sharing.

Organizational

This alternative explanation predicts that technology sharing policy should be a product of the established SOPs of the ministries involved in making those decisions. In general, military organizations should resist sharing technology since armed forces usually protect information and scientists should favor information sharing because of their habit of openness. Military organizations should prefer more open technology sharing policies with countries with whom they are allied and actively fighting alongside. It could also predict technology sharing if the organization involved thought the technology sharing would substantially advance a major organizational interest.

1. What was the role of military organizations in shaping the sharing decision?

The Air Ministry and Admiralty essentially had total control of the technology sharing policies for their respective equipment during this time.

2. If military organizations were involved in the decision, were those armed forces operating in close quarters with the potential recipient state's armed forces?

No. At no point during the period discussed in this case were U.S. and British forces operating in conjunction with one another. Neither state was at war.

3. What was the role of scientific organizations in shaping the sharing decision?

None. Discussions of technological exchange with the United States in this phase occurred through military and naval challenge only.

Given these factors, organizational explanations would predict that military and naval organizations should have had important influence over the decision to share technology with the United States. The expected SOP would be to protect secrets and avoid sharing technology, and neither the Air Ministry nor the Admiralty had strong organizational interests to support sharing. The Air Ministry had a strong organizational interest in gaining technology which would enhance its ability to conduct strategic bombing. While this interest explains the Air Ministry's strong interest in gaining the Norden Bombsight, it does not provide any rationale for the Air Ministry to share its own technology – though at the very end of the phase the Air Ministry, did for the first time, offer to trade technology for the Norden. Thus, in this period organizational theories would predict not technology sharing.

Table 5-1: Theory Predictions and Actual Values for Technology Sharing Pre-War						
	TOTT	Structural Realism	Economic	Organizational	Actual Desired	Actual Observed
Admiralty	None	Ambiguous	None	None	Minimal	Minimal
Air Ministry	None	None	None	None	None	None

The Failure of Appeasement and the Phony War

A week after Boyle told Pirie to offer to trade technology for the Norden Bombsight, Britain's appeasement policy collapsed. On 13 March 1939, Hitler invited Slovakian leader Jozef Tiso to Berlin to encourage him to declare an independent Slovakia. The next day the Germans told Czechoslovakian President Emil Hácha the German Army would invade his country and he could submit and cooperate or suffer the consequences. On 15 March, the German occupied the remainder of Czechoslovakia. Neither the British nor the French took military action, but the debate over whether Hitler could be trusted was over. British interest in technology sharing increased.

On May Day 1939, Kingsley Wood, the British Secretary of State for Air, met unofficially with the U.S. Ambassador in London Joseph Kennedy. Wood suggested an exchange of technical information. Critically, for the first time, he offered to trade Britain's most important technological secret: Radio Direction Finding. Kennedy relayed the message to the State Department in Washington. The State Department referred the matter to the War Department. Though his technical experts were away, the Secretary of War Harry Woodring wasted no time in rejecting the offer, certain that the War Department was ahead in any radar related research and constrained by FDR's commitment not to share secret technology.[580]

[580] Phelps, *The Tizard Mission*.

The security situation in Europe continued deteriorating over the summer. In mid-August 1939, the Air Ministry finally requested official assistance from the Foreign Office in securing the Norden bombsight. At this point, the Foreign Secretary Lord Halifax thought no time remained to waste. He skipped the professional diplomats and requested Prime Minister Chamberlain write directly to FDR. With knowledge that German troops had already gathered on the German-Polish border, Chamberlain sent his message on August 25th.[581]

That same day Britain signed the Polish-British Common Defense Pact committing Britain to help defend Poland. The move worked. Hitler had intended to invade Poland on August 26th. Now, he postponed the invasion. But the hold lasted less than a week. On September 1st, 1939, German tanks crashed into Poland. The day before, FDR had definitively rejected Chamberlin's request for the Norden Bombsight.[582]

On September 3rd, Britain and France declared war against Germany. The dreaded conflict had come. Less than an hour after Chamberlain addressed the nation on the BBC with news of the war, the air-raid sirens sounded. It proved a false alarm, but the hair-trigger posture that generated it betrayed a country on edge. Britain braced for air attack. Traffic on major roads was restricted so people could only travel away from the capital. Three million evacuated. Hundreds of thousands of London pets were euthanized lest the coming air raids kill their owners and leave them wandering.[583] Air raids would also endanger Britain's industry as it produced the munitions need for the war. But nothing happened. The predicted air raids did not occur – yet.

Though Britain sent little help to Poland, it wasted no time in preparing for war in the west. On the day Britain entered the war, the Cabinet appointed a commander of the British

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[581] Zimmerman, *Top Secret Exchange*, 41.
[582] Zimmerman, 41.
[583] Phelps, *The Tizard Mission*, 51.

Expeditionary Force (BEF). The next day, the BEF began landing in France. Royal Air Force squadrons flew to the continent as well. In conjunction with the French, Admiralty imposed a new blockade on Germany. The British Government reorganized for war. It installed a new Ambassador in Washington – Lord Lothian, a newspaper magnate with deep American connections. September 3rd also saw Neville Chamberlain announce his War Cabinet. As part of that change, he brought Winston Churchill back into the Government as First Lord of the Admiralty.

Soon after, Churchill attempted to re-open technological exchange with the Americans. Not long after Churchill became First Lord, FDR began corresponding with him. Churchill took full advantage. On October 16th, 1939, without consulting anyone, Churchill offered to provide the United States the latest British asdic technology (better known by its American name – sonar) for hunting submarines. Churchill did not suggest any quid pro quo; only that the Americans needed to protect the technology's secrets.[584] Asdic was the Admiralty's most prized technological secret, one it expected would play an essential role in the U-Boat war. [585] Throughout the previous two years of attempted exchanges, the Admiralty had maintained concerns about the ability of the U.S. Government to keep secrets – just as they had in the early 1920s.[586] FDR relayed this offer to the Navy Department who passed it to Captain Kirk in

[584] Winston Churchill, Cable to FDR, "Secret and Personal for the President. The Following from Naval Person," 16 October 1939 in Warren F. Kimball, *Churchill and Roosevelt, Volume 1: The Complete Correspondence - Three Volumes* (Princeton: Princeton University Press, 2015), 28, https://muse.jhu.edu/book/61199.

[585] It is unclear how seriously one should take Churchill's offer. The message to FDR was short, and Churchill almost just tosses the offer in amidst other news – and a claim that with new ASDIC two destroyers can do the work of 10. Churchill says nothing about negotiations only the British were "quite ready" to share the secret. Zimmerman suggests Churchill made the offer without consulting the Board of the Admiralty. While Churchill's offer may have only been a trial balloon to see if the United States was interested before opening a negotiation, it seems it was serious. Churchill would later mention the American's apparent unwillingness to take up his offer as a reason for his skepticism about technology sharing – a point is unlikely to have made if he had not been serious in his offer. Zimmerman also takes the offer at its face. Zimmerman, *Top Secret Exchange*, 43.

[586] While I have been unable to locate any primary sources that assessed whether contemporary observers believed detailed technical knowledge of asdic would have allowed the Germans to develop better technical or tactical

London. The American Director of Naval Intelligence Admiral W.S. Anderson – a former naval attaché in London himself – directed Kirk to get whatever he could from the British during the negotiations while giving up as little as possible. Only as a last choice was Kirk permitted to make an even trade of anti-submarine warfare technology.[587]

On November 9th, Captain Kirk met with the British Director of Naval Intelligence Admiral John Godfrey to discuss the offer. Kirk did not know that the offer had originated with Churchill, and his request for asdic surprised Godfrey. Godfrey was willing to open the negotiations, but because asdic was still considered "a very secret matter" he made no commitment.[588] Kirk expected that he would need to make a full disclosure of their sonar technology as quid pro quo.[589]

Just five days before, on November 4th, 1939, the U.S Congress had passed a new neutrality act. The law created a new policy which became known as "Cash and Carry." Whereas previously it was illegal for anyone to export weapons from the United States to any country at war, now warring states could purchase American weapons if they paid cash and American ships did not have to transport them. Since the Germans had few international financial assets and the Allied blockade had isolated German, the policy clearly favored the British and French. The British made no delay in reestablishing the British Purchasing Commission in New York two

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countermeasures, conversations with present day U.S. Navy submarine officers on the subject suggests it would have.

587 W.S. Anderson, Director of Naval Intelligence, Letter to Alan Kirk, U.S. Naval Attaché London; 20 October 1939, Folder: A8-3--A8-3/EF13 (Aug-1940); Box 230: A8-3 to A8-3/EF13 1940-1941 – SECRET (Box 230); Entry UD16 Formerly Security-Classified General Correspondence of the CNO/Secretary of the Navy 1940-1947 (Entry UD16); General Records of the Department of the Navy 1798 -1947, Record Group 80 (RG 80); National Archives Building, Washington, DC (NAB).

588 Alan Kirk, U.S. Naval Attaché London, Letter to W.S. Anderson, Director of Naval Intelligence; 9 November 1939, Folder: A8-3--A8-3/EF13 (Aug-1940); Box 230; Entry UD16; RG 80; NAB.

589 Alan Kirk, U.S. Naval Attaché London, Letter to W.S. Anderson, Director of Naval Intelligence; 9 November 1939, Folder: A8-3--A8-3/EF13 (Aug-1940); Box 230; Entry UD16; RG 80; NAB.

days later.[590] Cash and Carry would remain the primary way the British could access American industry output until the passage of the Lend-Lease Act in March 1941.

When FDR responded to Chamberlain's request for the Norden Bombsight in August, he had explained how the Neutrality Act prohibited the United States from making the bombsight available only to some countries. Now that the law had changed, the Air Ministry decided it was time to try again. On November 27th, Godfrey received approval to release asdic to the U.S. Navy, but U.S. sonar information was no longer enough. The British believed that the American technology would be inferior to their own. Britain would only provide asdic if the United States would share the Norden bombsight.[591]

The British made their offer through multiple channels. Kingsley Wood met again with Ambassador Joseph Kennedy to make the proposal. Kennedy agreed to present it on his upcoming visit to Washington. On December 5th, the Foreign Office directed Lord Lothian to make the proposal to FDR in Washington, too. Lothian visited the White House on December 13th and proposed the trade. FDR reiterated the concern he had expressed earlier about the bombsight potentially falling into enemy hands before the United States ever employed it in war. Prepared, Lothian proposed adding a self-destruct device to the bombsight that would destroy it if the bomber carrying it were shot down. FDR remained unconvinced and refused to provide a firm answer. Though Kirk would continue meeting Godfrey in London, by March 1940 he had received no counteroffer on the exchange of asdic and was told to drop the subject until the British raised it again.[592] Over the following months Lothian continued try to convince FDR to

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[590] R.A.L Smith, "Anglo-American Relations on Questions Affecting Aircraft Production and Aeronautical Research," 10 September 1942, TNA: AVIA 38/237, p. 1.
[591] Phelps, *The Tizard Mission*, 63.
[592] Alan Kirk, U.S. Naval Attaché London, Letter to W.S. Anderson, Director of Naval Intelligence; 14 March 1940, Folder: A8-3--A8-3/EF13 (Aug-1940); Box 230; Entry UD16; RG 80; NAB. W.S. Anderson, Director of Naval

release the bombsight, but he made no progress. Relations between the British and American navies became decidedly chilly. Godfrey came to see the desire for a quid pro quo as part of the problem.[593] Any chance for technology sharing appeared stalled.

The Origins of the Tizard Mission

Henry Tizard was one of the most prominent scientists in the British Government. An outstanding student, he studied in Germany after he completed his degree at Oxford in mathematics and chemistry. When the First World War began, he joined the artillery before becoming a test pilot and then working at the Ministry of Munitions. After the war, he returned to Oxford where he developed the numerical system for rating octane still used today. By 1933, he was chairing the Committee for the Scientific Survey of Air Defence, often known simply as the Tizard Committee. The Tizard Committee sponsored the 1935 experiment that lead to Radio Direction Finding (RDF – the original British name for early versions of what we now call radar), and Tizard continued to work on the subject.

In 1937, Tizard had proposed the British send a scientific attaché to Washington to keep appraised of American scientific work. Rejected at that time, the war led him to raise the issue again in October 1939 in his capacity as the Air Ministry science advisor. Tizard suggested Professor A.V. Hill fill this role, and the Air Ministry approved almost immediately – though Hill would not leave for the United States until March 1940. Tizard saw Hill's visit to the United States as a chance to get "American scientists into the war before their government," though it appears he initially thought more of liaison than technology sharing.[594] By the time Hill left, the Air Ministry had another motivation to send him. It still wanted the Norden bombsight, and the

Intelligence, Letter to Alan Kirk, U.S. Naval Attaché London; 1 April 1940, Folder: A8-3--A8-3/EF13 (Aug-1940); Box 230; Entry UD16; RG 80; NAB.
[593] Zimmerman, *Top Secret Exchange*, 45–47.
[594] Clark, *Tizard*., 250.

existing paths to acquiring it appeared blocked. The Air Ministry hoped Hill would survey American technical capabilities thus providing it new information it could use to negotiate a technological exchange.[595]

Hill began his mission in Canada, arriving in Halifax around March 21st, 1940. Within a week, he was in Washington.[596] Though no complete record of his schedule exists, Hill met widely. He consulted British officials across North America including Lothian; Air Commodore Pirie, the air attaché; the British High Commissioner in Canada; Dean C.J. Mackenzie, the head of the Canadian National Research Council; and both uniformed and civilian members of the British Purchasing Board – charged with procuring supplies for the British war effort.[597] All believed the British could gain technology from the Americans and felt that such interchange would improve the relationship.

More importantly, Hill met with a wide range of American scientific, intellectual, and industrial leaders including: Vannevar Bush, the President of the Carnegie Foundation, who would soon become the head of the new American National Defense Research Committee; Harvard President James Conant; Alfred Loomis; Supreme Court Justice Felix Frankfurter; Ernest Laurence, for whom Laurence-Livermore National Laboratory is today named; as well as the former President of the Western Electric Company; the head of Bell Labs who was also the President of the National Academy of Science; and two Vice-Presidents of AT&T.[598] He found them all eager to help the British and in support of technological exchange. He met with leaders

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[595] Zimmerman, *Top Secret Exchange*, 51.
[596] A.V. Hill, Letter A-3/12-27 to Henry Tizard, 28 March 1940, TNA: AIR 20/1362.
[597] A.V. Hill, "R.D.F. in Canada and the United States and a proposal for a general interchange of scientific and technical information, and of Service experience, between the Defense Services of Great Britain and those of the United States," 18 June 1940, TNA: AIR 20/2361.
[598] A.A. Washington Telegram 4222 22/4 to Air Ministry, 23 April 1940, TNA: AIR 20/2361; A.V. Hill, "R.D.F. in Canada and the United States and a proposal for a general interchange of scientific and technical information, and of Service experience, between the Defense Services of Great Britain and those of the United States," 18 June 1940, TNA: AIR 20/2361.

of the U.S. Navy and Army Air Corps and reported similar attitudes.[599] Both Bush and Frankfurter, who were close to FDR, believed that if the British pitched a "frank offer to exchange information and experience,' the president would accept it.[600]

He also became convinced the Americans had made much more significant progress developing radar than the British had perceived. Hill could get little solid information on American progress on the subject, but he took that as an indication in and of itself.[601] He was denied access to some private facilities and when visiting other facilities which were likely to be researching the topic, he was assigned an escort.[602] Leaders of corporate electronics firms told him they would love to help the British but were prohibited by the Government.[603] Additionally, two anonymous letters appeared at the British Embassy that suggested using radio waves for various air defense functions. The President of Swarthmore College, who was connected with the War Department, asked Hill, "What are you people doing with radio waves reflected from aircraft for directing anti-aircraft gunfire…Don't tell me if you think you oughtn't to."[604] While Hill could not be exactly sure of American progress, based on the secrecy, he believed the Americans were focused on shorter radio waves than the British, which meant they might have

[599] A.V. Hill, "Comments and Notes" for Sir Henry Tizard, Air Ministry, 7 April 1940, TNA: AIR 20/2361.
[600] A.V. Hill, "R.D.F. in Canada and the United States and a proposal for a general interchange of scientific and technical information, and of Service experience, between the Defense Services of Great Britain and those of the United States," 18 June 1940, TNA: AIR 20/2361.
[601] A.V. Hill, Letter to Henry Tizard, 19 April 1940, TNA: AIR 20/2361.
[602] A.V. Hill, "R.D.F. in Canada and the United States and a proposal for a general interchange of scientific and technical information, and of Service experience, between the Defense Services of Great Britain and those of the United States," 18 June 1940, TNA: AIR 20/2361.
[603] A.V. Hill, A.A. Washington Telegram 5036 to Air Ministry, 27 April 1940, TNA: AIR 20/2361; A.A. Washington Telegram 4222 22/4 to Air Ministry, 23 April 1940, TNA: AIR 20/2361.
[604] A.V. Hill, "R.D.F. in Canada and the United States and a proposal for a general interchange of scientific and technical information, and of Service experience, between the Defense Services of Great Britain and those of the United States," 18 June 1940, TNA: AIR 20/2361.

information beneficial to the British even if he believed the British effort was still more advanced.[605]

As early as April 7th, Hill was writing to Tizard advocating for the British to begin providing information to the Americans – though it almost certainly took weeks for the letter to reach England.[606] The next day, the war changed dramatically. Since early in the war, the British and French had considered occupying Norway. Doing so would tighten the Allied blockade of Germany and cut German supplies of Swedish iron ore. The Germans, recognizing this danger and that Norway would provide excellent bases for U-boats, considered their own invasion. The Norwegians remained steadfast in their neutrality. On March 28th, the British and French jointly decided to mine Norway's coastal waters to impede German shipping.[607] The day after Hill wrote to Tizard, the Allies began their mining operation, but it was too late. German ships filled with troops were already underway. Overnight, the German invasion began, and by the afternoon of April 9th, German troops had occupied most Norwegian cities. The British moved units to Norway, and for the first time in the war, British and German troops engaged in ground combat.

Hill made his formal recommendation that the British provide technology to the Americans. He worked with Ambassador Lord Lothian and air attaché Air Commodore Pirie to do so. On April 23rd, Lothian telegraphed the Foreign Office: the Americans had "great facilities … for rapid development and production of … R.D.F." Lothian "strongly support[ed]" Hill's recommendation for detailed information exchange. He believed the British bargaining position could only worsen as the Americans made further technical progress. He also suggested

[605] A.V. Hill, "R.D.F. in Canada and the United States and a proposal for a general interchange of scientific and technical information, and of Service experience, between the Defense Services of Great Britain and those of the United States," 18 June 1940, TNA: AIR 20/2361.
[606] A.V. Hill, "Comments and Notes" for Sir Henry Tizard, Air Ministry, 7 April 1940, TNA: AIR 20/2361.
[607] Phelps, *The Tizard Mission*, 118.

exchanging R.D.F. might finally provide a way to get the Norden bombsight.[608] The next day Pirie made his recommendation to the Air Ministry. He too provided strong support for Hill's proposal to exchange R.D.F. information but did not mention bombsights.[609] Both thought such efforts would have salubrious effects on Anglo-American relations.

In fact, these combined recommendations were important not just for their proposal for open exchange, but also because of the rationale behind them. Pirie said nothing about the bombsight and thought the British could speed their own research and gain American goodwill. Lothian mentioned the bombsight as an afterthought. The thrust of his message was not just about the exchange of scientific information, but access to American industry. Lothian suggested requesting "complete facilities to obtain the latest types of instruments and equipment to [British] specifications and requirements from firms … working on United States Government contracts."[610] Indeed, Hill himself took this view. His support for sharing technology with the Americans was based on "exchange *or* … to encourage them to give [the British] rather free run [italics added]" with American defense suppliers.[611]

The recommendation gained immediate attention in London, but the response was mixed. George Lee, the Air Ministry's Director of Communication Development, with responsibility for R.D.F., opposed sharing information on R.D.F. with the Americans without more knowledge of what they had already discovered. Though he respected Hill, Lee noted that Hill was not an R.D.F. expert.[612] Robert Watson-Watt, the Air Ministry Scientific Advisor in

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608 Lord Lothian (Washington), Telegram No. 595 to Foreign Office, 23 April 1940, TNA: Premier 3/475/1, p. 36.
609 Air Attaché Washington, Telegram 4332 23/4 to Air Ministry, 24 April 1940, TNA: AIR 2/7193, Document 1c.
610 Lord Lothian (Washington), Telegram No. 595 to Foreign Office, 23 April 1940, TNA: Premier 3/475/1, p. 36.
611 A.V. Hill, "Comments and Notes" for Sir Henry Tizard, Air Ministry, 7 April 1940, TNA: AIR 20/2361.
612 George Lee (Director Communication Development), Minute to D of S, 26 April 1940, TNA: AIR 2/7193, Document 2A.

Telecommunication, was more optimistic, but while he favored sharing British technology with the U.S. Government, he opposed providing it to American firms.[613]

But even as the bureaucracy debated, the War Cabinet responded. Hill himself had noted that the decision to share technology with the Americans on such a scale would affect every service and thus would require a War Cabinet discussion.[614] He might not have expected it would happen so quickly. On April 26th, just two days after Lothian's telegram was decoded in London, the Foreign Secretary Lord Halifax presented it the War Cabinet. But the conversation still focused on a quid pro quo exchange for the Norden bombsight. Halifax reported (incorrectly) that Lothian had told him the Americans had already shared all their technological secrets except two, including the bombsight. Chamberlain suggested that Lothian should again propose the R.D.F. for Norden trade. Only, Samuel Hoare, who had replaced Kingsley Wood as Secretary of State for Air just three weeks before, focused on the Air Ministry's shortage of scientists and the benefits of research cooperation on R.D.F itself. Despite this conversation, the Cabinet made no firm decisions.[615]

For the supporters of exchange of information in the Air Ministry, however, this discussion appeared to signal Prime Minister Chamberlain's general support. The Air Ministry leadership took it as such.[616] On May 1st, they called an interdepartmental conference for May 3rd with the Admiralty and War Office to discuss sending an R.D.F. mission to the United States. So confident was the Air Ministry in the exchange that they included such details as deciding who

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613 R.A. Watson-Watt (S.A.T), Minute, 27 April 1940, TNA: AIR 2/7193, Document 3.

614 "I suppose this question of sharing information with the Americans is almost a Cabinet matter, scarcely to be decided by on Ministry: for example, the R.D.F. story affects all three Defense Ministries." A.V. Hill, "Comments and Notes" for Sir Henry Tizard, Air Ministry, 7 April 1940, TNA: AIR 20/2361.

615 "Conclusions of a Meeting of the War Cabinet held at 10 Downing Street, S.W.1, on Friday, April 26, 1940, at 11:30. A.M," W.M. (40) 104th Conclusions, 26 April 1940, TNA: CAB 65/6/49.

616 F.H Sanford (Private Secretary to Air Minister), Minute to C.A.S., 26 April 1940, TNA: AIR 2/7193, Document 6A; Air Ministry Draft Letter S.4471/S.6 to A.E. Percival (WO) and G. Blake (Admiralty), No Date [18 May 1940], TNA: AIR 2/7193, Document 28A.

should participate in the mission and how to reply to Lord Lothian's telegram on the agenda. Notably, the agenda eschewed talk of the bombsight, focusing on exchanging R.D.F. technology for American "radio methods" and access to "manufacturing and development facilities."[617]

For an outside observer that day, such confidence would have appeared reasonable. The day after the Cabinet met, scientific and research directors from across the British government including the Department of Scientific and Industrial Research, Admiralty, Ministry of Supply, and the Air Ministry, including the previously skeptical Lee, endorsed Lothian's proposal to approach FDR for a "complete interchange of information and possibilities for supply on all recent work" in defense including radio work.[618] And the same day that the Air Ministry proposed the meeting, the Admiralty had finally provided the American naval attaché Captain Kirk some of the information he had requested on German magnetic mines and degaussing.[619]

When the conference convened two days later it was no doubt surprising, when the Air Ministry ran into an Admiralty roadblock. The other departments did not agree that the Cabinet meeting on April 26th had authorized a mission.[620] The Air Ministry's scientific leadership was strongly represented, including Tizard, Watson-Watt, and Lee, but they could not close the deal. Everyone agreed that freely exchanging "Most Secret" information with the United States would produce important political benefits. The Admiralty, however, raised a "very grave objection from the standpoint of defense security." They feared "unavoidable risk of immediate leakage to the enemy" of any secrets provided to the Americans.[621] This echoed concerns that Admiral

[617] Air Ministry S.6, Memorandum to C.A.S., 1 May 1940, TNA: AIR 2/7193, Document 9A.
[618] R.A. Watson-Watt (S.A.T), Minute, 27 April 1940, TNA: AIR 2/7193, Document 3.
[619] Hackmann, *Seek & Strike: Sonar, Anti-Submarine Warfare and the Royal Navy 1914-1954*, 259.
[620] Air Ministry Draft Letter S.4471/S.6 to A.E. Percival (WO) and G. Blake (Admiralty), No Date [18 May 1940], TNA: AIR 2/7193, Document 28A.
[621] "Note of a Meeting held in Air Ministry, While Hall, on 3rd May 1940, at 4 p.m. to discuss Exchange of Secret Information on R.D.F. with the U.S.A," 3 May 1940, TNA: AIR 2/7193, Document 12A.

Godfrey had expressed to Captain Kirk in their negotiations in January.[622] As such, the principal result of the meeting was to agree that the Air Ministry should draft a paper on the pros and cons of exchange and the Admiralty should provide an addendum documenting their security concerns. The issue would then be pushed up again for discussion.

The resulting draft paper laid out all sides of the argument. Of the seven arguments various British officials would make in favor of an open exchange of information at various times, the paper included all of them, except for the potential for gaining the Norden bombsight. It gave most prominence to the political advantages full exchange of defense information would create, but it included five more concrete advantages. First, Britain could gain access to advanced American technology, though it noted most believed the British had more to give than the Americans. Second, the British could mobilize American research labs to pursue British research priorities since the Americans had more research resources. Third, as Hill and Lothian had advocated, the British could gain access to American industrial production. The British might gain higher priority access to existing production of American technology and have the chance to shape it to British needs. But fourth, if the British shared their technology with the Americans, they could also get American factories to manufacture British devices. The paper noted that British production was increasing and was expected to meet British needs and that it would take time for American production of British technology to come online, but that American industry could still provide an important buffer against German air attacks targeting British factories. Finally, the paper noted that, if at some future point the Americans joined Britain in the war, providing British technology now would mean that the American forces

[622] Zimmerman, *Top Secret Exchange*, 47.

would already have begun equipping themselves with the latest, war-tested technology.[623] Besides the direct advantages which would accrue to Britain, providing British technology now would make America a stronger ally in the future.

The paper also noted the single major downside: security. If the British provided R.D.F. to the Americans, it could leak to the Germans. The consequences of such a leak were perceived to be severe. The Germans could use the technology to improve their own air defenses. In early May 1940, the British knew the Germans were researching using radio waves to detect aircraft but had no evidence they had implemented it. The paper suggested that if the Germans gained the British technology, it would save them a year's work. It also noted the operational dangers of the Germans gaining the information. The Germans could begin work on countermeasures or they could simply bomb the British R.D.F. network – known as Chain Home or CH – early in any bombing campaign. While the Germans might begin to develop these countermeasures eventually, the longer it took, the better. The paper concluded that concrete advantages of sharing the technology with the Americans and the risks of it getting to the Germans were about equal. More senior leaders would need to decide the issues based on the potential political gains.[624]

After the meeting the bureaucracy began its churn. It had taken a few days to draft the paper on the advantages and disadvantages of sharing technology with the United States. The Air Ministry began internally circulating the draft on May 7th. The same day the Admiralty provided its "appendix" documenting problems with American security.[625] It consisted of two memoranda,

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[623] Draft "Note on the relative advantages and disadvantages of exchange with the U.S.A. of Information on R.D.F. and other Radio Developments." No Date [May 1940], TNA: AIR 2/7193, Document 12B.
[624] Draft "Note on the relative advantages and disadvantages of exchange with the U.S.A. of Information on R.D.F. and other Radio Developments." No Date [May 1940], TNA: AIR 2/7193, Document 12B.
[625] G.F. Somerville, Letter to R.H. Peck, 7 May 1940, TNA: AIR 2/7193, Document 13A.

one from the Director of Naval Intelligence and the other from an Assistant Chief of Naval Staff, Sir Geoffrey Blake, who had previously been naval attaché in Washington. Both simply stated their opinions that American security arrangements were poor and could not be trusted.[626] Meanwhile, the next day, Tizard responded with his comments on the draft memo. He again pushed the argument that the sooner the British gave their technology to the Americans, the sooner the Americans could begin producing it for the British.[627] He also suggested the gains of the mission were worth the risk of leak, especially since American security seemed good enough to keep the British from knowing their precise progress with radio research. To further reduce security risk, he suggested the mission take any evidence of failed American secrecy to confront the Americans and ask for their improvement.[628]

Before the bureaucracy could finishing preparing its arguments, the political environment changed. The Norwegian campaign had gone poorly. The same day as the Air Ministry had begun circulating the pros and cons of sharing technology with the United States, Parliament had begun what became known as the Norway Debate about the conduct of the war. On May 8th it became clear that Chamberlain had minimal support to continue as Prime Minster. On the 9th, Parliamentary leaders agreed Winston Churchill would be the candidate to succeeded him. On May 10th, Hitler intervened in dramatic fashion. In the pre-dawn hours, German tanks hurtled across the borders of Belgium, the Netherlands, Luxembourg, and France. The Phony War was over.

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[626] Minute by John Godfrey (British Director of Naval Intelligence), 4 May 1940, TNA: AIR 2/7193, Document 13B; Geoffrey Blake [A.C.N.S.(A)], Minute. 4 May 1940, TNA: AIR 2/7193, Document 13C.
[627] Henry Tizard, Recommended Changes to Draft "Note on the relative advantages and disadvantages of exchange with the U.S.A. of Information on R.D.F. and other Radio Developments," No Date [8 May 1940], TNA: AIR 2/7193, Document 19B.
[628] Henry Tizard, Minute to A.C.A.S.(G), 8 May 1940, TNA: AIR 2/7193, Document 19A.

DV

1. Did the ministries support any sharing of military related technology? If yes, what technology sharing policy did they support?

Yes. Throughout the period the British Admiralty continued to support quid pro quo technology exchange with the United States, even as it became frustrated with the challenges of that exchange. The agreement for exchange of boom defense for carrier landing technology occurred right around the same time as Germany occupied the remainder of Czechoslovakia. These negotiations had been ongoing for almost a year, and it does not appear that the German action broke a previous negotiating statement, so the argument is not that the increased threat level lead to this exchange but rather to demonstrate the continuity of the Admiralty's policy.

This Admiralty preference for quid pro quo exchange continued even after the war began. Churchill, as First Lord, did offer asdic to the United States shortly after coming into office in September 1939 without specifically stating any requirements for exchange. As we have seen, however, once the two navies began actual negotiations on the subject, an expectation of a quid pro quo emerged. Moreover, Churchill's offer was never meant as a broad-based offer of technology sharing, but rather a one-off transfer of information. Thus, throughout this period the Admiralty supported a minimal technology sharing policy.

During this period, the Air Ministry came to support a minimal technology sharing policy as well. It made its first, minor, offer to share technology with the United States in March 1939, suggesting a trade of gun turret technology for the Norden bombsight. Another two months passed until the Air Ministry became willing to offer R.D.F. for the bombsight in May 1939. By August of that year, such an exchange had become a national priority, and the Foreign Office would support it. The Air Ministry also sponsored A.V. Hill's Mission during this period to lay the groundwork for future potential technology exchange. After that mission, the Air Ministry slowly became even more interested in technology sharing and in access to American research and development labs and production. The ongoing relationships these sorts of interactions would require would have meant the Air Ministry would have needed to establish an ongoing technology sharing relationship with the United States. This relationship would still, however, have been limited to precisely defined areas – like R.D.F. By the end of this period, then, the Air Ministry was supporting a specified technology sharing policy characterized by ongoing exchange for a limited set of defined technologies. Thus, overall during this period, we see the Air Ministry transition from a minimal to a specified technology sharing policy.

TOTT

1. What motivations, if any, did decisionmakers have to share technology? Did the sharing state face a severe and immediate threat that it shared with the potential recipient state?

During this period Britain continued to face an increased threat from Germany but not yet a severe and immediate threat. The German occupation of Czechoslovakia, breaking the Munich agreement – as part of which Hitler had claimed he had no further territorial demands in Europe – indicated the failure of appeasement. After this point, the British recognized they could no longer accommodate German expansion. This change in attitude along with continued German aggression led to the British declaration of war on September 3rd. To some extent once the war began, however, the German threat proved less severe than initially anticipated. Major air raids did not appear at the start of the war. British ground forces would not engage the Germans until the Norway Campaign in April 1940.

While the Germans posed a general threat to Britain during this time, due to the ways in which they would be employed, that threat had different implications for the Admiralty and Air

Ministry. While both Germany and the Allies generally refrained from launching air raids against each other's cities during the Phony War, the threat of such raids existed. The RAF needed to be prepared both to launch and defend against such raids. The Air Ministry's willingness to share technology with the Americans only began as it became clear appeasement had failed and accelerated as the war approached. In the reports from the United States, Hill specifically spoke about the advantages of getting the Americans to produce British R.D.F. technology and to research continued improvements. This support would have bolstered British defenses while locating research and production in an area secure from the risk of German air raids – a point Hill and Tizard made.[629] Technology sharing with the United States would have provided direct benefits to the Air Ministry's war effort as the threat worsened.

The Admiralty's interests were less directly threatened. Without a doubt the coming of the war meant the Royal Navy would be in combat, but the threat against which it needed to defend was less severe that that facing the Air Ministry during the period. The German Navy was relatively weak, and the British had a geographical advantage of Britain's position relative to Germany. While most of the German fleet was at sea at the outbreak of the war, Germany had few long-range submarines at the start of the war. Additionally, German surface ships and submarines soon needed to return to Germany or find neutral ports for re-supply. Once in German bases, German ships needed to pass through British controlled chokepoints to reach the Atlantic. This situation coupled with a particularly cold winter in 1939-1940 that iced over many Baltic ports meant that the Allied navies faced relatively few challenges during the first months of the war. This situation made Admiralty interested in minimal technology exchange, but not

[629] A.V. Hill, "Research and Development for War Purposes in Canada," 17 June 1940, TNA: AIR 20/2361; Henry Tizard, Recommended Changes to Draft "Note on the relative advantages and disadvantages of exchange with the U.S.A. of Information on R.D.F. and other Radio Developments," No Date [8 May 1940], TNA: AIR 2/7193, Document 19B.

much more than it had been pre-war. In this period, Germany threatened Britain, but the threat was neither severe nor immediate.

2. How did sharing state decisionmakers assess future interest alignment with the potential recipient state?

This period saw no major changes in the way British decisionmakers assessed their future interest alignment with the United States. Indeed, even as British officials complained about the lack of American security commitments to Britain, they generally acknowledged that Britain could not win a long war without the help of the United States.[630] They were confident that the United States did not pose a future threat to Britain. This point was made particularly strongly in a bizarre memo by Robert Randall presented to the War Cabinet in October 1939 urging the British Government to pursue a propaganda strategy towards Germany that advocated blaming the United States and the Monroe Doctrine for Germany's inability to expand and colonize South America.[631] On its face, it would seem that the advocate of such a position would see British and American interests diverging in the future, so the fact the author does not is striking. Randall acknowledges that while the United States was unlikely to help Britain win the war per se, it would enter the war to ensure Germany would not win.[632] In this goal, British and American interests aligned. Even more striking, however, after arguing that British propaganda needed to unite Europeans against the Monroe Doctrine, Randall claimed that an "attack on the Monroe Doctrine [was] not an attack on the United States."[633] He went on to explain multiple reasons

[630] Alan P. Dobson, *Anglo-American Relations in the Twentieth Century: Of Friendship, Conflict and the Rise and Decline of Superpowers* (London New York: Routledge, 1995), 70.
[631] Robert Randall, "Note Upon the Primitive Emotions and Precision in Propaganda, in relation to the Enemy, and to the United States of America," 9 October 1939, TNA: CAB 63/99.
[632] Robert Randall, "Note Upon the Primitive Emotions and Precision in Propaganda, in relation to the Enemy, and to the United States of America," 9 October 1939, TNA: CAB 63/99 p. 43.
[633] Robert Randall, "Note Upon the Primitive Emotions and Precision in Propaganda, in relation to the Enemy, and to the United States of America," 9 October 1939, TNA: CAB 63/99 p. 47.

why a war between the United States and Britain would not occur. If even an advocate of British collaboration with Germany and other European powers to colonize South America thought war with the United States would not occur, this provides strong evidence that the British did not see the United States as a future threat to British interests.

Advocates of sharing technology with the United States made the same assessment. Hill reported a conversation in April 1940 with an unnamed British naval intelligence officer in the United States who assessed that Britain did not need to worry about the United States opposing it in the war at any point and might come in on the British side.[634] Thus, during this period the British continued to view their future interests as compatible with the United States and did not view the United States as a future threat.

3. Did the decisionmakers express concerns about the ability of the recipient state to protect technological secrets?

Yes. As previously discussed, the British, and particularly the Admiralty, harbored concerns about the ability of the United States to keep information from leaking to the Germans. As early as January 1940, Captain Kirk, the American naval attaché in London, reported to Washington that the Admiralty was becoming less willing to share technical information with the Americans because they believed that it might leak to the Germans.[635] The Admiralty made these same arguments, forcefully, at the 3 May 1940 interdepartmental conference to discuss sending a technology sharing mission to the United States.[636] Indeed, the Admiralty used these concerns to force the issue to decision at a higher level.[637]

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[634] A.V. Hill, "Comments and Notes" for Sir Henry Tizard, Air Ministry, 7 April 1940, TNA: AIR 20/2361.
[635] Zimmerman, *Top Secret Exchange*, 47.
[636] "Note of a Meeting held in Air Ministry, While Hall, on 3rd May 1940, at 4 p.m. to discuss Exchange of Secret Information on R.D.F. with the U.S.A," 3 May 1940, TNA: AIR 2/7193, Document 12A.
[637] Minute 25 to VCAS by R. Peck (ACAS(g)), 14 May 1940, TNA: AIR 2/7193.

The Air Ministry acknowledged the potential risk that sharing information with the Americans might entail, but believed it was possible to mitigate it. An internal Air Ministry backgrounder from late 1942 noted that concerns about American security procedures prior to the U.S. entering the war had been an item of concern for British leaders, but it suggested these concerns had induced caution rather than stopping sharing all together.[638] This attitude matches contemporary sources. For example, Hill wrote to Tizard in early April 1940 that he thought it would be important to get a guarantee from the Americans that they would protect any information the British provided from leaking to the Germans, but unlike the Admiralty, he believed that with proper effort the Americans could keep secrets. As others would later, Hill noted that American security had been sufficient to protect the Norden Bombsight from the British.[639] Undoubtedly, Hill's own difficulty in getting precise information about American progress on radar also influenced his opinion. Tizard similarly was more willing to trust American security measures. Like Hill, he commented on the inability of British intelligence to get much leaked information from the United States as evidence of American security. Tizard argued that the British should take any evidence of lax American security and present it to the Americans as part of their negotiations for adequate measures.[640] Of course, this argument was just as likely to be a ploy to force the Admiralty to provide their best evidence of American security problems.

The Admiralty may not have had much. Though the Crown spy scandal had been big news in 1938, it had also driven German espionage deeper underground. While most of the

[638] R.A.L Smith, "Anglo-American Relations on Questions Affecting Aircraft Production and Aeronautical Research," 10 September 1942, TNA: AVIA 38/237, p. 5
[639] A.V. Hill, "Comments and Notes" for Sir Henry Tizard, Air Ministry, 7 April 1940, TNA: AIR 20/2361. Though not the Germans, who had stolen it in 1938.
[640] Henry Tizard, Minute to A.C.A.S.(G), 8 May 1940, TNA: AIR 2/7193, Document 19A.

German spy apparatus in the United States had survived, it became less active. While this change was in part because of the scandal, it was also because of shifting priorities. As Hitler began gobbling up territory in Europe, German intelligence became much more concerned with gathering information about the order of battle in Europe. As Hitler prepared to launch his attacks on France, he specifically tasked the German Foreign Ministry with keeping the United States out of the war. One part of this program was minimizing any German espionage activity lest its exposure turn the United States against German. On April 25, 1940, Joachim von Ribbentrop, Hitler's top diplomat, met with the head of German intelligence, Admiral Wilhelm Canaris to reinforce this message. The story was not quite so simple, however. Even as Canaris reassured Ribbentrop that the Germans were not spying on the U.S. Army or Navy, he was directing his office to redouble efforts to steal American technological information.[641] Still, the earlier shift in priorities and the caution induced by the German high command's desire to avoid major incidences reduced the chances the British knew of the German activities.

The Air Ministry had an entirely separate reason they believed the additional risk of sharing with the Americans was probably less than what the Admiralty thought. The Air Ministry believed there was already an increased likelihood that the Germans might have the information. One official noted that the British had already given the details of R.D.F. to help the French. Additionally, even before the end of the Phony War the Germans may have captured a British aircraft fitted with an earlier air to surface radar called A.S.V.[642] If the Germans already had the information, the British would be keeping the secret from the Americans for no good reason – at least as the Air Ministry saw it. Thus, while the Admiralty believed that American

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641 Farago, *Game of the Foxes*, 297.
642 ACAS(G), Memorandum to S6 - Recommended Changes to Draft "Note on the relative advantages and disadvantages of exchange with the U.S.A. of Information on R.D.F. and other Radio Developments," No Date [May 1940], TNA: AIR 2/7193, Document 19B.

security was so lax that any information shared with them was likely to reach the Germans, the Air Ministry did not believe American security problems were so severe.

Single-Period Structural Realism & Technological Capability

The threat to Britain, at least as perceived by the British, increased during this period. Since this theory sees international threat as the motivation for technology sharing, it would predict this threat should have increased British desire for technology sharing. While the initial failure of the appeasement policy in March 1939 should have led to a recalculation, the actual outbreak of war with German in September 1939 should have led to an even larger increase in sharing. These factors, however, should be weighed against the likelihood the British thought the Americans would enter the war against Germany, which was still low. Thus, this theory is ambiguous in the technology sharing policy it would predict. Still, it does accurately predict increasing interest both at the Air Ministry and the Admiralty.

Economic

The economic alternative explanation holds that states should share technology when they will gain economic benefits from the sharing and stop technology sharing when the sharing would make them less economically competitive. This approach cannot explain why Britain chose to begin sharing technology with the United States. Indeed, the times in this case when decisionmakers did explicitly consider economic factors, they were set aside or quickly subordinated to security concerns.

1. Did the sharing arrangement involve monetary payments to a sharing state?

No. No monetary payment from the United States to Britain occurred as part of any technology sharing in this period.

2. Did leaders cite economic benefits as an important rationale or haggle over them?

No. While the British and Americans spent 1939 and early 1940 haggling over technology exchange without success, this haggling always involved trading technology for technology, never money. These discussions occurred between naval, military and occasionally diplomatic officials and did not involve economic officials.

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

No. British leaders did not discuss the potential of future (or contemporary) economic competition with the United States when considering technology sharing during this period.

In summary, this alternative explanation would predict that neither the Admiralty nor the Air Ministry would favor technology sharing.

Organizational

1. What was the role of military organizations in shaping the sharing decision?

The Air Ministry and Admiralty continued to play key roles in organizing technology sharing, though civilian leaders began to take more interest in the issue in this period. As 1939 progressed, the Air Ministry sought the assistance of the Foreign Office and the Prime Minister in arranging technology exchange with the Americans, but the Air Ministry organized and sponsored A.V. Hill's mission to the United States which set the stage for the Tizard Mission. Still, even after the War Cabinet discussed technology sharing with the United States in April, the Ministries' interpretations of the conversation seemed to matter more than the War Cabinet discussion itself. The Admiralty demonstrated its power in May 1940 when it challenged the Air Ministry's interpretation of the War Cabinet's potential support for sending a mission to the United States.

2. If military organizations were involved in the decision, were those armed forces operating in close quarters with the potential recipient state's armed forces?

No. The United States had not yet entered the war. The United States Navy did undertake neutrality patrols in the Western Atlantic from the day after Britain and France declared war on Germany, but while these operations favored the British, the U.S. and Royal Navies were not formally coordinating or operating together.

3. What was the role of scientific organizations in shaping the sharing decision?

Independent scientific organizations did not play an important role in the British technology sharing decisions in this phase, but scientists, particularly scientists associated with the Air Ministry, did. Henry Tizard was a major advocate for sharing technology with the United States from his position as Air Ministry science advisor long before he was selected to lead the mission that would bear his name. Similarly, A.V. Hill proved to be a strong proponent when sent to the United States as were other scientists with whom Tizard consulted. Nonetheless, these officials did not have independent decision-making authority.

Given these factors, organizational explanations would predict that military and naval organizations should have had important influence over the decision to share technology with the United States. Scientific organizations would have less influence. Because the U.S. and British armed forces were not fighting side-by-side in any of the periods under examination, organizational explanations would predict that both the Air Ministry and Admiralty, with their standard preference for secrecy, would have opposed sharing technology with the Americans. Individual scientists who supported sharing should have found minimal support for their ideas, and ministries should have generally tried to obstruct sharing – a technology sharing policy of none. These predictions do relatively well describing the Admiralty's attitude towards technology sharing even if organizational theories do not perfectly predict the Admiralty's minimal technology sharing policy. This explanation does not explain the Air Ministry's strong desire for a more liberal technology sharing policy.

Table 5-2: Theory Predictions and Actual Values for Technology Sharing during the Failure of Appeasement and Phony War						
	TOTT	Structural Realism	Economic	Organizational	Actual Desired	Actual Observed
Admiralty	None	Ambiguous	None	None	Minimal	Minimal
Air Ministry	Specified	Ambiguous	None	None	Specified	Minimal

The Blitzkrieg

Lightning War Brings Lightning Changes

The Germans achieved unimaginable success with their invasion of France and the Low Countries. Just two days after their invasion they reached Sedan and captured its bridges across the Meuse River intact. The Allies counterattacked. On May 15th, with the counterattack defeated, the German panzers broke into the mostly undefended French countryside and raced for the English Channel. The French commander assessed that the Germans could reach Paris in two days. Churchill made his first request to FDR for a loan of American destroyers and other war material. By May 18th, the Germans were little more than 50 miles from reaching the coast and splitting the British Expeditionary Force from the majority of the French Army. On May 20th, the Germans reached the sea.

Historians of the Tizard Mission have suggested the German offensive and the speedy deterioration of the Allied position pushed consideration of technology sharing with the Americans to the back burner.[643] The record does not support this argument. Rather, with the critical exception of Winston Churchill himself, the rapidly increasing threat to Britain highlighted to all the importance of engaging with the Americans. Indeed, the chronology of

[643] Zimmerman, *Top Secret Exchange*, 61; Phelps, *The Tizard Mission*, 70.

worsening news from France and the shift in the position of British ministerial leaders moved almost in lockstep. Churchill became Prime Minister and Minister of Defence on the evening of May 10th, but it took him a day to turn over his position as First Lord of the Admiralty to Albert V. Alexander. Thus, it was on Churchill's first full day as Prime Minister and last day as First Lord of the Admiralty, that he confirmed the Admiralty's position on exchange on information. Churchill thought the Americans might only be six or eight months behind Britain in radar technology, so little was to be gained by accelerating American progress. Instead, in his role as First Lord, he again focused on the Norden bombsight, but even as he did so, he denigrated its value. It was "almost certain" that the bombsight's technology was "no great novelty," but he recognized that the British needed help producing bombsights. He would only consider exchanging R.D.F. for the delivery of thousands of complete bombsights.[644]

When Churchill made this decision, however, the Germans had yet to break through the Allied lines. The changing situation on the ground would directly affect the discussions of technology sharing in the British government. On May 14th, as the French attempted to seal the Sedan breakthrough, Air Vice-Marshal R.H. Peck, who had chaired the May 3rd meeting, forwarded the updated advantage-disadvantage paper to the Admiralty and War Office. He noted that since the meeting "the character of the war [had] greatly changed."[645] He also noted how the new situation altered the risk of R.D.F. leaking to the Germans via the Americans – though his arguments were not entirely consistent. German POWs had stated that the Germans were further along in using radio waves to detect aircraft than the British had realized; the Germans had likely already captured British R.D.F. gear in France; and the increased pace of the war would diminish

[644] J.H. Peak Letter to J.J Balfour (Foreign Office), 11 May 1940, TNA: AIR 2/7193, Document 23A.
[645] R.H. Peck, Letter S.4471/ACAS(G)/1927 to K.M. Loch (War Office), 14 May 1940, TNA: AIR 2/7193, Document 24B.

the risk the Germans would be able to get any technology that leaked to them via the Americans into production before the war ended.[646] The updated memo recognized these changes and noted that the British had already fully disclosed R.D.F. to the French. While still recognizing some risk in sharing with the Americans, it made a stronger case for sharing than the earlier draft.[647] The next day, General Loch responded for the War Office endorsing the new memo.[648]

Within the Air Ministry, Peck was even more direct about how the adverse turn in the war had affected his opinion. He wrote, "My own conclusion on this very difficult matter of policy is, in the circumstances of the war as they have now revealed themselves, that we ought to make this exchange with U.S.A. at once."[649] He suggested the issue be brought immediately to the Chiefs of Staff and then to the War Cabinet. On May 18th, with the Germans 50 miles from the coast, the Vice Chief of the Air Staff agreed and ordered the issue on the agenda.[650] The secretary, not understanding its importance, prepared the subject for the deputies instead.[651] As it turned out, it would not matter because the Admiralty acted first.

On that same day, May 18th, the First Sea Lord, the most senior officer in the Royal Navy, Sir Dudley Pound raised the issue of technological exchange with the United States at the Chiefs of Staff Meeting. The change in Allied fortunes had completely reversed the Admiralty's position. As recorded in the minutes of the meeting,

> The Admiralty thought that the time had now come to ask that the Prime Minister should suggest to the President of the United States that we should pool our technical knowledge. They would be prepared to give the Americans full details of our secret equipment such as magnetic mines and

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[646] R.H. Peck, Letter S.4471/ACAS(G)/1927 to K.M. Loch (War Office), 14 May 1940, TNA: AIR 2/7193, Document 24B; R.H. Peck, Letter S.4471/ACAS(G)/1927 to James F. Somerville (Admiralty), 14 May 1940, TNA: AIR 2/7193, Document 24A.
[647] "Note on the relative advantages and disadvantages of the exchange with the U.S.A. of Information on R.D.F. and other Radio Developments," No date [14 May 1940], TNA: AIR 2/7193, Document 28B.
[648] K.H. Loch (War Office), Letter to R.H. Peck (Air Ministry, 15 May 1940, TNA: AIR 2/7193, Document 27A.
[649] Minute 25 to VCAS by R. Peck (ACAS(G), 14 May 1940, TNA: AIR 2/7193.
[650] Minute 26 by P.M. to ACAS(G), 18 May 1940, TNA: AIR 2/7193.
[651] Minute 28 to ACAS(G) by M. J. Mackenzie, 18 May 1940, TNA: AIR 2/7193.

asdics. He understood that the Americans were working on the use of very short waves in connection with R.D.F., and their knowledge might effect an improvement in this equipment.[652]

The Admiralty was all in on technical exchange. The Chief of the Air Staff coyly stated that he would need to consult with his technical experts – who had been suggesting such a policy for weeks – but that he agreed. The Chief of the Imperial General Staff did not think the Army had much to offer, but as a result also supported the proposal.[653] The services were aligned. That they were add weight to the argument that international threats rather than organizational proclivities drove their position.

Though the Chiefs of Staff had agreed that the Air Ministry would take the lead on preparing a technology sharing mission, the Admiralty continued to take the initiative and pushed the subject to the Prime Minister. On May 20th, the same day that the German armies reached the Channel coast and the day after Lord Gort, the Commander of the British Expeditionary Force in France, ordered a withdrawal towards Dunkirk, the new First Lord A.V. Alexander wrote to Churchill stating, "the time [had] come" for the British to gain American confidence by "an unrestricted offer to pool technical information."[654] Alexander proposed accepting an American request to place combat observers aboard Royal Navy ships, believing that doing so would ease the work of acquiring supplies in the United States. He further argued that Churchill should offer to "release [technological] secrets without restraint" to the Americans.[655] Alexander specifically stated his belief that the offer be made so that there was "no appearance" of an attempt to bargain.[656] In addition to generating goodwill, Alexander argued

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652 War Cabinet Chiefs of Staff Committee, "Extract from the Minutes of 138th Meeting," 18 May 1940, TNA: WO 193/306.
653 War Cabinet Chiefs of Staff Committee, "Extract from the Minutes of 138th Meeting," 18 May 1940, TNA: WO 193/306.
654 A.V. Alexander, Letter to Winston Churchill, 20 May 1940, TNA: Premier 3/475/1, p. 66/7.
655 A.V. Alexander, Letter to Winston Churchill, 20 May 1940, TNA: Premier 3/475/1, p. 66/7.
656 A.V. Alexander, Letter to Winston Churchill, 20 May 1940, TNA: Premier 3/475/1, p. 66/7.

that sharing technology with the Americans would mean their forces would be better prepared should the United States eventually enter the war.

Churchill, however, was not yet prepared to endorse technology sharing, even as he reconfigured his government for the next phase of the war. The same day as Alexander's letter, the War Cabinet carved a new Ministry of Aircraft Production out of the Air Ministry to separate the functions of supplying and fighting the air war. Lord Beaverbrook, a newspaper baron and friend of Churchill's, became the new minister. The decision created another ministry with a stake in technology sharing. The next day, May 21st, Churchill responded to Alexander's letter. Churchill's failed attempt to trade asdic for the bombsight had lessened his interest in technology sharing, and he did not believe "a wholesale offer of military secrets [would] count for much at [that] moment."[657] Still, given the rapidly evolving situation on the continent, Churchill did not want to close the door. He decided to "wait a few days" before deciding.[658]

It took almost a week for this message to reach the Air Ministry. In the meantime, knowing the services all agreed on pursuing technology sharing, it circulated a draft response to Lord Lothian's April 23rd telegram. The responses still mentioned the Norden bombsight but prioritized British interest in access to American labs and exchanging information on R.D.F.[659] The Admiralty responded with notification of the hold the Prime Minister had placed on any technology sharing on May 27th.[660] For a few days the bureaucracy waited, but then it began asking for an answer.

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[657] Winston Churchill, Letter to A.V. Alexander, 21 May 1940, TNA: Premier 3/475/1, p. 65.
[658] Winston Churchill, Letter to A.V. Alexander, 21 May 1940, TNA: Premier 3/475/1, p. 65.
[659] Air Ministry, Draft Telegram to H.M. Ambassador Washington, No Date [24 May 1940], TNA: AIR 2/7193, Document 34D.
[660] Clifford Jarrett, Letter to F.H. Sanford, 27 May 1940, TNA: AIR 2/7193, Document 37A.

On June 4th, the day Dunkirk fell, the Air Ministry asked Downing Street for an update. It also mentioned a Times of London article which reported on a new secret American airplane detection device that appeared to be radar.[661] The next day, Churchill's science advisor, Frederick Lindemann wrote him supporting exchanging information with the United States, if they could keep secrets. Lindemann, like Churchill had in early May, denigrated the value of the Norden Bombsight technology compared to British advances, unless the Americans could deliver thousands of completed bombsights for British use.[662] Churchill still delayed, writing that he wanted more help from the United States before offering more.[663] On June 15th, the day after Paris fell, the Admiralty took a turn writing Downing Street to request an update on a decision on information sharing, asking "in view of the pace at which events have moved since the earlier exchange of letters" did "the Prime Minister still [consider] a full exchange untimely."[664] The next day, Phillipe Petain became Premier of France and sent peace feelers to the Germans. The day after, he made a radio broadcast to France declaring the time for fighting had passed. The same day Churchill asked General Hastings Ismay, his chief military aide, his opinion of sharing technology with the Americans. The secretary who wrote the note stated his own support.[665] Ismay immediately responded noting not only his support but the approval of the Chiefs of Staff a month before on May 18th.[666]

The worsening situation in Europe had distressed A.V. Hill and Lord Lothian in Washington. They had heard nothing on the subject since Lothian had sent his message in late April, almost two months before. They decided their best chance was for Hill to return to London

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661 F.H. Sanford, Letter for E.A. Seal, 4 June 1940, TNA: AIR 2/7193, Document 40A.
662 Frederick Lindemann, Minute to Winston Churchill, 5 June 1940, TNA: Premier 3/475/1, p. 60.
663 Winston Churchill, Minute on Frederick Lindemann's 5 June 1940 Letter, TNA: Premier 3/475/1, p. 60.
664 Bernard Sendall for C.G. Jarrett, Letter to E.A. Seal, 15 June 1940, TNA: Premier 3/475/1, p. 59.
665 E.A. Seal, Minute to H.L. Ismay, 17 June 1940, TNA: Premier 3/475/1, p. 58.
666 H.L. Ismay, Minute to Mr. Seal, 17 June 1940, TNA: Premier 3/475/1, p. 57

to make his case in person. He departed for Britain the same day Dunkirk fell. Upon arriving he produced two reports with recommendations based on his time in the United States.[667] They made no new arguments about technology sharing, but they provided more detail. On June 21st, he forwarded them to the Secretary of State for Air, the Chief of the Air Staff, and the Minister for Aircraft Production.[668] The same day Italy invaded France. Archibald Sinclair, the Secretary of State for Air, needed little reminding. Lord Hankey, the sole minister without portfolio in Churchill's war cabinet, had told the Air Ministry the day before that he thought the Secretary of State for Air needed to push the issue with Churchill.[669] When Sinclair responded thanking Hill on the 22nd, he wrote that the question of technology sharing was "very much in our minds."[670]

The same day that Sinclair responded to Hill, France surrendered to Germany. But the fighting did not stop. The Germans would keep attacking until France surrendered to Italy too. It took two more days of negotiation. Finally, a half hour after midnight on June 25th, the Battle of France came to end. Sinclair seized the moment. He wrote to Churchill making the case for a technology sharing mission to the United States, which Churchill had stayed for "a few days" more than a month before. Sinclair made familiar arguments. The Americans wanted to help, but the British needed to move first. The Fall of France meant the Germans had already gained many British secrets. By providing the newest radio technology to the Americans, the British could then get American factories to manufacture it for them. This production would provide insurance

[667] A.V. Hill, "Research and Development for War Purposes in Canada," 17 June 1940, TNA: AIR 20/2361; A.V. Hill, "R.D.F. in Canada and the United States and a proposal for a general interchange of scientific and technical information, and of Service experience, between the Defense Services of Great Britain and those of the United States," 18 June 1940, TNA: AIR 20/2361.
[668] A.V. Hill, Letter to Henry, Tizard, 20 June 1940, TNA: AIR 20/2361; A.V. Hill, Letter to the Secretary of State for Air, 21 June 1940, TNA: AIR2/7193, Document 47A.
[669] Joubert, Minutes 20 June 1940, TNA: AIR 2/7193, Document 46A.
[670] Archibald Sinclair, Letter to A.V. Hill, 22 June 1940, TNA: AIR 2/7193, Document 47D.

against German air raids and save the British from needing to retrofit American-made aircraft with improved British turrets. The British could also benefit from access to American research.[671]

On June 27th, Churchill wrote to Lord Beaverbrook, the Minister of Aircraft Production. Churchill wanted Beaverbrook's opinion on Sinclair's letter – the two were often at odds. In doing so, Churchill acknowledged that the Fall of France had changed the situation – especially since it meant the Germans would likely gain access to much of what Britain had shared with France.[672] Beaverbrook responded immediately, and for once agreed with Sinclair. Beaverbrook advocated sharing all Britain's secrets with the Americans, though he argued that Britain should receive payment either in money or in-kind compensation such as ships, planes, guns.[673] Neither Sinclair, Beaverbrook, nor Churchill mentioned the Norden bombsight.

That same day Lord Lothian telegrammed again from Washington. It had been two months since he had made his proposal about sharing technology with the Americans, and despite the back and forth in London, he had heard nothing back. Lothian worried that unless the British acted soon, the factions in the United States that thought Britain was already "a lost cause" would gain ground.[674] In the end Lothian's final plea did not matter. Just hours before it reached Churchill on June 30th, the Prime Minister responded to Sinclair's request. Churchill approved the mission.[675]

It is worth assessing for a moment why Churchill required so much cajoling to initially authorize the mission, if only, because as we will see, he continued to be its biggest obstacle.

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[671] Archibald Sinclair, Letter to Winston Churchill, 25 June 1940, TNA: Premier 3/475/1, p. 38.
[672] Winston Churchill, Letter to Lord Beaverbrook (Minister for Aircraft Production), 27 June 1940, TNA: Premier 3/475/1, p. 54.
[673] Lord Beaverbrook, Letter to Winston Churchill, 27 June 1940, TNA: Premier 3/475/1, p. 53.
[674] Lord Lothian (Washington), Telegram No. 1147 to Foreign Office, 27 June 1940, TNA: Premier 3/475/1, p. 37.
[675] For Churchill's decision see Winston Churchill, Minute to the Secretary of State for Air, 30 June 1940, TNA: Premier 3/475/1, p. 52. For the delay in receiving Lothian's telegram see John R. Colville, Minute for the Prime Minister, 30 June 1940, TNA: Premier 3/475/1, p. 48.

With the fall of France, Churchill was convinced that Britain needed to find a way to get more assistance from the United States and eventually bring the United States into the war. Over the summer he was repeatedly engaged in negotiations with FDR for American support, which FDR was sometimes more and sometimes less willing to provide. Churchill's hesitance likely came from a combination of two places. First, Churchill would repeatedly refer to his early "free" offer of asdic to FDR. Its failure may have convinced Churchill that Tizard's "costly signal" strategy to build trust would fail too. Second, Churchill knew he had few chips to play in his negotiations with the United States. He likely feared that giving some of them up for (potentially) nothing would have a real cost. Not only would Churchill lose the ability to bargain with R.D.F. going forward, but the offer might also make British appear desperate – which in fairness they were.

The Bumpy Road to Departure

When Churchill initially approved the mission, he put only one condition on it – that he be given a list of the secrets that the mission would give the Americans before it did so. If only getting the mission out the door would have proved so simple.[676] Still, with Churchill's authorization the bureaucracy sprang into action to prepare for a potential mission. Because all the ministries, indeed essentially everyone but Churchill, had agreed as to the value of sharing technology with the Americans since late May, the interdepartmental coordination went smoothly. On July 3rd, the Air Ministry, which had the lead for the mission, inquired of the Admiralty, War Office, Ministry of Aircraft Production, and Ministry of Supply what information they could provide the Americans and who they would like to send.[677] By the next day, the Foreign Office, War Office, Air Ministry, and Ministry of Supply had all approved the

[676] Winston Churchill, Minute to the Secretary of State for Air, 30 June 1940, TNA: Premier 3/475/1, p. 52
[677] A.C.A.S.(R)., Minute to V.C.I.G.S. and V.C.N.S, 3 July 1940, TNA: AIR 2/7193, Document 60A.

language of a telegram to send to Lothian instructing him to propose the exchange to FDR.[678] The message made clear that the British wished to avoid any bargaining. They would offer their full technical information to the Americans and ask for their help. It briefly mentioned concerns about "indirect disclosure to the enemy."[679] Despite Lord Lothian having sent a follow-on telegram about the Norden Bombsight – in which he reported FDR thought he could get Congress to release it as soon as the British proved to him the Germans had something similar – on July 2nd, the negotiating request made no mention of it.[680] The Foreign Office dispatched the request on July 6th.[681]

Lord Lothian went to work. He arranged to meet with FDR on July 9th.[682] At that meeting, he presented the British proposal. Britain wished to undertake "an immediate and general interchange of secret technical information with the United States" with a focus on radio.[683] Britain wanted to avoid bargaining and would provide details on any equipment the United States wished without demanding anything in return, though the British hoped the Americans would reciprocate by sharing their technology. Lothian specifically offered information on using radio waves to detect approaching aircraft from the ground and from British planes and to direct anti-aircraft guns. He stated the British were "anxious to be permitted to employ the full

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678 W.J Mackenzie, Air Ministry Memorandum S.4471/S.6. to J. Balfour, 4 July 1940, TNA: AIR 2/7193, Document 62C.
679 Foreign Office, Telegram No. 1414 to Lord Lothian (Washington), 6 July 1940, TNA: Premier 3/475/1, p. 40.
680 Lord Lothian (Washington), Telegram No. 1202 to Foreign Office, 2 July 1940, TNA: Premier 3/475/1, p. 44
681 Foreign Office, Telegram No. 1414 to Lord Lothian (Washington), 6 July 1940, TNA: Premier 3/475/1, p. 40.
682 FDR Presidential Library, "July 9th, 1940," FDR: Day by Day, accessed March 1, 2021, http://www.fdrlibrary.marist.edu/daybyday/daylog/july-9th-1940/.
683 Lord Lothian, British Ambassador to the United States; Aide-memoire to the President of the United States; 8 July 1940; Folder: Folder of Key Documents Pertaining to Various Aspects of the Work of OSRD 1940-43; Box 5: Other Miscellaneous Files (Box 5); NC-138 Entry 2 Office of the Chairman NDRC & Director OSRD Correspondence Re Reports to the President: Reports to the President, 1941-1944 (Entry 2); Office of Scientific Research and Development, Record Group 227 (RG 227); National Archives at College Park, MD (NACP).

resources of the radio industry" in the United States.[684] Lothian also offered to make the British service attachés available to the War and Navy Departments if they wanted to consult prior to making a final decision. The desperate situation in which the British found themselves meant they did not have much leverage to bargain, but even so, they did not even *try* to bargain. Rather they made a costly signal of their friendship, offering what they had without demanding anything in return in the hope that the Americans might reciprocate.

FDR raised the subject two days later on July 11th at his next cabinet meeting. Unfortunately, little information survives as to FDR's motivations or the discussion that occurred. FDR prohibited the taking of minutes at his cabinet meetings, and none of the officials who sometimes made notes about cabinet meetings after returning to their offices made mention of the decision.[685] What we do know is that FDR with the agreement of his cabinet agreed to receive a small British mission of technical exchange, though it would take some time for the War and Navy Departments to provide a formal response.[686] They were, however, unwilling to buck the President's directive.

Why did FDR make this decision? The scanty record makes assessment difficult, but FDR was deeply concerned about the implications of the Fall of France. He had begun preparing his own bipartisan "war cabinet." Republican Henry Stimson had become Secretary of War the on July 10th, and Frank Knox, another Republican, became Secretary of the Navy the same day

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684 Lord Lothian, British Ambassador to the United States; Aide-memoire to the President of the United States; 8 July 1940; Folder: Folder of Key Documents Pertaining to Various Aspects of the Work of OSRD 1940-43; Box 5; Entry 2; RG 227; NACP.

685 Sarah Nevins, Franklin D. Roosevelt (FDR) Presidential Library Archivist, Email to Author, 28 May 2019; Henry Morgenthau Jr, Presidential Diary Volume 3, May 16, 1940 – February 28, 1941, FDR Presidential Library. Available online: http://www.fdrlibrary.marist.edu/archives/collections/franklin/index.php?p=collections/findingaid&id=535.

686 Henry L. Simson, Secretary of War; Letter to the Acting Secretary of State; 22 July 1940; Folder: Secret #991 to 1100; Box 6: Secret 851-1250 (1940) (Box 6); NARS A-1 Entry 88 Secretary of War Classified Files 1932-1942, 1937-42 (Entry 88); Records of the Office of the Secretary of War, Record Group 107 (RG 107); NACP.

as the cabinet meeting. Nonetheless, historian David Reynolds argues that while FDR generally supported Britain throughout 1940, between mid-June and August 1940 he was generally unwilling to make commitments, fearing that Britain, like France, could fall.[687] Zimmerman, however, rightly points out, that accepting the British Technical Mission – as it came to be called – involved almost no risk. The small size of the proposed mission meant it would be easy to keep it secret. Moreover, the mission offered the Americans the chance to gain from British technology and war experience, which could improve American readiness. Since accepting the mission required no commitment of productive capacity (or commitment of anything at all for that matter), FDR ran no risk of impeding American war preparations, and he would leave selection of the American technologies which might be disclosed to the Army and Navy.[688]

In London, a week and a half went by since the Foreign Office had ordered Lothian to make the proposal, and they had heard nothing from him. On July 17th, the Foreign Office requested an update.[689] Lothian replied the next day that he had been told informally that the mission was approved but was awaiting a formal response.[690] The American Departments were discussing what technology they would like to share and what concerns or conditions they had about the proposed mission.[691] By July 22nd, these concerns were resolved. FDR informed Lord Lothian the United States would welcome the mission.[692] The State Department added that the

[687] David Reynolds, *The Creation of the Anglo-American Alliance, 1937-41: A Study in Competitive Co-Operation* (Chapel Hill: University of North Carolina Press, 1982), 109, https://catalog.hathitrust.org/Record/000762648.
[688] Zimmerman, *Top Secret Exchange*, 74.
[689] Foreign Office telegram 1555 to Lord Lothian (Washington), 17 July 1940, TNA: AIR 2/7193, Document 81A.
[690] Lord Lothian (Washington), Telegram No. 1394 to Foreign Office, 18 July 1940, TNA: Premier 3/475/1, p. 30.
[691] Henry L. Simson, Secretary of War; Letter to the Acting Secretary of State; 22 July 1940; Folder: Secret #991 to 1100; Box 6; Entry 88; RG 107; NACP; H.R. Stark (Chief of Naval Operation), Memorandum to the Chiefs of the Bureaus of Ships, Ordnance, and Aeronautics, and the Directors of Naval Communications, Fleet Training, War Plans Division, and Naval Intelligence, and the Technical Aide to the Secretary of the Navy; 17 July 1940; Folder: A8-3—A8-3/EF13(Aug-1940); Box 230; Entry UD16; RG 80; NAB.
[692] Lord Lothian (Washington), Telegram No. 1474 to Foreign Office, 22 July 1940, TNA: Premier 3/475/1, p. 29.

situation remained that if the British wished to have anything made in the United States, the War and Navy Departments would need to approve it first.[693]

While waiting for the American response, however, Churchill had second thoughts. He was frustrated with the slowness of American support.[694] On July 17th, they day before the War Cabinet was scheduled to ratify the mission, Churchill wrote an irritated analysis to General Ismay:

> I do not myself see what we are going to get out this arrangement. Are we going to throw all our secrets in the American lap, and see what they give us in exchange. If so I am against it. It would be very much better to go slow, as we have far more to give than they. If an exchange is to be arranged, I should like to carry it out piece by piece.... Generally speaking, I am not in a hurry to give our secrets until the United States is much nearer to the war than she is now. I expect that anything we give to the United States Services…goes pretty quickly to Berlin.... What is the urgency of this matter?[695]

This screed marked a dramatic turn from Churchill's earlier agreement. Ismay understood that reneging on the offer already made to the Americans could have disastrous consequences for Anglo-American relations. A consummate aide, he sought to arrange the situation so that Churchill would not blow up the entire effort. The next day, Ismay provided a detailed response answering Churchills concerns.[696] Ismay reminded Churchill of Hill's assessment of American progress and Lord Lothian's support. He outlined the support of the Air Ministry, Admiralty, and the Ministry of Aircraft Production. He reminded Churchill that the best argument in support of the mission was that providing British technology to the Americans meant that American factories could include it when filling orders for Britain.[697] Finally, Ismay most likely delayed the

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[693] Note to the British Embassy, Enclosure to Department of State Memorandum Eu: 811.24 E ½ to the Secretary of the Navy; 30 July 1940; Folder: A8-3—A8-3/EF13(Aug-1940); Box 230; Entry UD16; RG 80; NAB.
[694] Zimmerman, *Top Secret Exchange*, 82.
[695] Winston Churchill, Minute to General Ismay, 17 July 1940, TNA: Premier 3/475/1, p. 33/4.
[696] It is also possible, though by no means certain, that Ismay was behind the 17 July telegram to Lothian asking for an update on the status of negotiations with the Americans. The telegram expressed an urgent desire for information, and if the Americans had already accepted the British proposal, it would be even more important that the British did not backout.
[697] H.L. Ismay, Minute to Prime Minister, 18 July 1940, TNA: Premier 3/475/1, p. 32. It is important to note however that at this point, prior to Lend-Lease, the British would still be paying the Americans for goods.

meeting planned for July 18th to allow his boss's mind to settle as no record of it exists nor do any documents after July 18th mention it.

The tactics worked. By the time Churchill finally convened with his Ministers to discuss the technical exchange of information with the United States on July 25th, the Americans had accepted the invitation and the supporters of the exchange had marshalled their arguments. As a result, the meeting focused not on whether the mission would occur but instead focused on what information should be shared, what the British desired in return, and who should go as part of it.[698] The next day the Air Ministry provided a precise list of the information it proposed to share and what it hoped to gain in return. Sinclair proposed offering information on R.D.F. and radio communications. He wanted the same from the United States, as well as access to factories to produce British technology in the United States. The Norden bombsight was not part of it.[699] Seemingly ready to fully support the mission, Churchill acknowledged the list and asked to be told when the other ministries had submitted their lists as well.[700]

On August 1st, Tizard, appointed to lead the mission, met with Churchill to discuss his imminent departure. He came with an agenda. Tizard had drafted his own terms of reference for the mission, politely titled "American Mission Suggestions" to present to the Prime Minister. Tizard saw his goal as helping "the armed forces of the U.S.A. to reach the highest level of technical efficiency."[701] Two of the four suggestions were important but administrative: securing personnel for the mission and requesting Churchill instruct all British technical representatives in

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[698] Lord Hankey, Letter to Winston Churchill, 25 July 1940, TNA: Premier 3/475/1, p. 27.
[699] Archibald Sinclair, Letter to Winston Churchill, 26 July 1940, TNA: Premier 3/475/1, p. 26. As would turn out, the Norden Bombsight had become such a political issue, that the United States would continue to refrain from disclosing it to the British until early.1942. When the British finally had a chance to evaluate it they largely dismissed its values, correctly noting that the amount of time it required pilots to fly in a straight line before dropping their bombs was impractical against a defended target. The irony of the entire episode is that German spies had stolen the secret in 1938. Zimmerman, *Top Secret Exchange*, 192. Miller, "Spies in America," 46–47.
[700] Winston Churchill, Minute to General Ismay, 27 July 1940, TNA: Premier 3/475/1, p. 26.
[701] H.T. Tizard, "American Mission Suggestions," 8 August 1940, TNA: Premier 3/475/1 p. 25.

North America to support the mission. He also reaffirmed that while he would get as much as he could from the Americans, Tizard would not bargain. Tizard's second suggestion, however, was most important: He wanted permission to tell the Americans whatever they wanted to know from a technical standpoint. Moreover, he wanted to have the authority to arrange for Americans to come to Britain to get more information if Tizard could not provide them enough.[702] In essence, Tizard refused to be bound by any of the pre-approved technology lists Churchill had requested. The mission was to engage in true, open technology sharing.

Churchill acquiesced. Tizard would get to run the mission how he pleased, but there was a catch. Though Churchill had supported Tizard at their meeting in the afternoon, by the evening, he was again frustrated with the Americans over what Churchill perceived as the lack of progress on what would become the Destroyers-for-Bases deal.[703] Churchill wrote to Ismay. He still agreed with all of Tizard's proposals, but he put a hold on Tizard's departure.[704]

It took many days of cajoling to get Churchill to change his mind. After two days, officials in the Air Ministry began asking what the hold meant for the mission.[705] After five days, it seemed that every party familiar with the planned mission was urging Churchill to let it go forward. On August 6th, Tizard wrote to Churchill worried the delay would undermine American views of British intentions.[706] The next day the Secretary of State for Air went to see Churchill about the issue.[707] The day after, General Ismay urged Churchill to authorize the mission as well, telling Churchill that an American naval mission had arrived in London for staff talks and

702 H.T. Tizard, "American Mission Suggestions," 8 August 1940, TNA: Premier 3/475/1 p. 25.
703 Zimmerman, *Top Secret Exchange*, 89.
704 Winston Churchill, Minute to General Ismay, 1 August 1940, TNA: Premier 3/475/1, p. 24.
705 E.S. Compton, Note to Minister, 3 August 1940, TNA: AIR 2/7193, Document 111B.
706 H. Tizard, Letter to Winston Churchill, 6 August 1940, TNA: Premier 3/475/1.
707 A. Rowlands, Letter to Henry Tizard, 7 August 1940, TNA: AIR 2/7193, Document 137A.

wanted to discuss technology making it difficult to hide the hold from the Americans.[708] The same day, the Foreign Secretary Lord Halifax told Churchill that FDR thought the mission important, and the British needed to provide him more information on the mission.[709] Lothian had telegrammed on August 2nd asking for details about the mission and provided a list of technologies in which the Americans were interested.[710] The combined effort worked. Churchill lifted the hold.[711]

Perhaps fearing another complication, Tizard worked to get to North America as soon as he could. He chose to leave ahead of the rest of his mission and to fly rather than transit by ship. Flying required some arranging as flying boat service to North American had only just resumed on August 4th.[712] Nonetheless, ten days later, Tizard took off bound for Montreal.

Over the next eight weeks, the Tizard Mission succeeded more than its biggest advocates might have hoped. The Americans were thoroughly impressed with what the mission offered. Both the U.S. Army and Navy as well as the newly formed civilian National Defense Research Committee threw open their arms to complete scientific cooperation. The British found that American researchers and engineers had devised technological advances in radio, radar, and sonar that complemented British designs. The Americans set up whole new research efforts to continue to develop the technologies the British provided, and American firms entered contracts to produce British designed equipment. In limited areas, the Americans even decided to adopt British designs for their own forces. Some members of the mission ended up staying in the United States months longer than expected to coordinate the continuing technical collaboration

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708 H.L. Ismay, Memo to Winston Churchill, 8 August 1940, TNA: Premier 3/475/1, p. 16.
709 Lord Halifax, Letter to Winston Churchill, 8 August 1940, TNA: Premier 3/475/1, p. 14-5.
710 Lord Lothian (Washington), Telegram No. 1587 to London, 2 August 1940, TNA: Premier 3/475/1, p. 22.
711 J.M. Martin, Letter to W.I. Mallet, 8 August 1940, TNA: Premier 3/475/1, p. 13.
712 *Pictorial History of the Second World War: A Photographic Record of All Theaters of Action Chronologically Arranged*, vol. 1 (New York: WM. H. Wise and Co., 1944), 220.

and exchange. This collaboration would soon be institutionalized through the creation of the British Central Scientific Office located in DuPont Circle and eventually the London Mission of the U.S. Office of Scientific Research and Development – an office which grew out of the NDRC. The open scientific exchange and collaboration the Tizard Mission initiated would continue through the end of the war.

DV

1. Did British decisionmakers support any sharing of military related technology? If yes, what technology sharing policy did the unit support?

Yes. During this period, almost the whole of the British Government came to support the ongoing exchange of information with the United States. The Air Ministry, War Office, Foreign Office, Ministry of Supply, Ministry of Aircraft Production, and Admiralty would all support ongoing sharing of information.[713] Though he took longer than most of his ministries, Winston Churchill also came to support the mission.

A discussion did occur within the Government as to whether the British should adopt a specified or an open technology sharing policy. For most of the spring and summer, it appeared that Churchill would require that he pre-approve the specific technologies that the mission would share.[714] Multiple ministries submitted lists for the Prime Minister's review.[715] This "allowlist"

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[713] For the War Office, see War Office Letter 86/Gen/5181 to Under Secretary of State for Air, 17 July 1940, TNA: AIR 2/7193, Document 83A. For the Foreign Office, see Lord Halifax, Letter to Winston Churchill, 8 August 1940, TNA: Premier 3/475/1; Minute by J.V. Perowne, 4 Oct 1940, A4419/16/45 TNA: FO 371/24226 p. 173. For the Ministry of Supply, see H.J. Gough (Director of Scientific Research), Ministry of Supply Letter 287/Gen/257(D.S.R.) to Philip Joubert de la Ferte, 6 July 1940, TNA: AIR 2/7193, Document 64A. For the Ministry of Aircraft Production, see AMDP, Minute for Minister of Aircraft Production, 29 July 1940, TNA: AIR 2/7193, No Document Number. Air Ministry and Admiralty support for information sharing has been previously discussed.

[714] Winston Churchill, Minute to the Secretary of State for Air, 30 June 1940, TNA: Premier 3/475/1, p. 52; Minute 85 by E.S. Jackson, 27 July 1940, TNA: AIR 2/7193; Office of the War Cabinet Letter to E.S. Jackson, 31 July 1940, TNA: AIR 2/7193, Document 97A.

[715] For the Ministry of Aircraft Production, see AMDP, Minute for Minister of Aircraft Production, 29 July 1940, TNA: AIR 2/7193, No Document Number. For the Ministry of Supply, see "Proposed interchange of Scientific Information with U.S.A. (Ministry of Supply Interest), 287/Gen/257/D.S.R., No Date [29 July 1940], TNA: AIR 2/7193, No Document Number. For the Air Ministry, see W.L. Mackenzie, "Note of Terms of Reference of Mission," No Date [9 July 1940 -prepared for meeting], TNA: AIR 2/7193, Document 66B.

approach authorizing specific areas of technology for ongoing exchange is the defining characteristic of a specified technology sharing policy.

In the end, however, the British Government adopted an open technology sharing policy – that is, one characterized by specifically identifying the technologies it would *not* give to the Americans (nascent jet engine technology in particular) – using blocklists. The Air Ministry and Ministry of Supply directly stated their support for an open technology sharing policy.[716] I have been unable to locate any evidence in which Admiralty officials state a preference between open and specified technology sharing policies. Because they did not object to the adoption of an open technology sharing – something we have seen they were willing to do earlier with other changes in technology sharing policy – I code their preferred policy as open. Tizard convinced Churchill to adopt it during their 1 August 1940 meeting, though later, after the mission returned, Churchill briefly tried to restrict the ongoing exchange more tightly, but other officials essentially refused to adopt this position.[717]

TOTT

1. What motivations, if any, did decisionmakers have to share technology?

The rapid success of the German invasion of France and the Low Countries created a severe and immediate threat to Great Britain which united the British government in their support for technology sharing with the United States. The French surrender heightened this

[716] For Ministry of Supply, see H.J. Gough (Director of Scientific Research), Ministry of Supply Letter 287/Gen/257(D.S.R.) to Philip Joubert de la Ferte, 6 July 1940, TNA: AIR 2/7193, Document 64A. For the Air Ministry, see E. S. Jackson, Letter to J.V. Perowne, 10 August 140, TNA: AIR 2/7193, Document 128A and H.T. Tizard, Letter to A. Rowlands, 1 August 1940, TNA: AIR 2/7193, Document 112A. For the Ministry of Aircraft Production see A. Rowlands, Letter S.4471/P.S.4 to the Under Secretary of State for Air, 3 August 1940, TNA: AIR 2/7193, Document 102A.

[717] For Churchill's view after Tizard returned from the United States, see Extract from War Cabinet Conclusions 293(40), 21 November 1940, A4879/16/45 TNA: FO 371/24226 p. 270. For final refusal to implement, see Draft Memorandum for the War Cabinet from the Minister of Aircraft Production, "Disclosure to the United States of American of Secret Information Relating to Supply Matters," No Date [~20 January 1941], TNA: CAB 21/2739. and its associated cover letter dated 21 Jan 1941 from W.L. Gorell Barnes in the same location.

threat since German forces could be concentrated against Britain alone. Almost day by day as news of the worsening situation reached Britain, British leaders became more in favor of sharing technology with the Americans. Notably, the Admiralty position shifted as the Germans reached the French coast, an achievement which would make it much harder for the Admiralty to stop German submarines bound for the Atlantic.

These events affected all the British services and the industrial effort for the war. First and foremost, the German capture of the Low Countries and the area of France along the English Channel meant that German aircraft would be well positioned to attack Britain. This put British industrial and research facilities at direct risk. It also placed the Air Ministry and the defensive system it had designed around R.D.F. front and center. The defeats of the spring of 1940 also worsened the Admiralty's position. No longer could it contain German naval forces using the North Sea chokepoints. Instead, German surface and submarine forces would have access to France's Atlantic ports for refit and resupply, greatly increasing the potency of the German counterblockade against Britain. The defeat also meant the British Army might need to defend against a foreign invasion for the first time in hundreds of years.

This situation heightened the advantages of technology sharing with the United States. With a slimmer margin for survival, any technology the United States might provide as a result of the offer could make the difference between victory and defeat. Similarly, secure American production facilities, American research, and saving the time needed to retrofit British technology onto American equipment could matter. The chance of warming the relationship with the Americans itself became of more value as the threat increased.

As a result, it is unsurprising that, as we have seen, shifts in British attitudes toward technology sharing tracked closely with the battlefield reality. The Admiralty, for example, began advocating for open technology sharing with United States as German forces reached the English Channel.[718] Indeed, those British officials advocating for technology sharing with the United States repeatedly referenced ongoing events. On May 14th, one of the Assistant Chiefs of the Air Staff wrote how "the circumstances of the war as they have now revealed themselves" made him think the Air Ministry needed to push the technology sharing issue immediately, and others agreed.[719] Similarly, when First Lord A.V. Alexander of the Admiralty wrote to Churchill on May 20th, he wrote how he was influenced by "the circumstances of our present situation" to begin sharing technology.[720]

These types of remarks recommenced after the German capture of Paris and continued through the French surrender. On June 15th, the Admiralty wrote the Prime Minister's office asking if "full exchange" was still "untimely" given "the pace at which events [had] moved since the earlier exchange."[721] After the French surrender, the Secretary of State for Air wrote on June 25th asking the Prime Minister "if [he did] not now consider the time … ripe" for an offer to share technology with the United States.[722] Clearly, the worsening military situation on the continent directly affected British decisionmakers' willingness to share technology with the United States.

2. How did sharing state decisionmakers assess future interest alignment with the potential recipient state?

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718 A.V. Alexander, Letter to Winston Churchill, 20 May 1940, TNA: Premier 3/475/1, p. 66.
719 Minute 25 to VCAS by R. Peck (ACAS(g), 14 May 1940, TNA: AIR 2/7193; Minute 26 by P.M. to ACAS(G), 18 May 1940, TNA: AIR 2/7193. R.H. Peck, Letter S.4471/ACAS(G)/1927 to K.M. Loch (War Office), 14 May 1940, TNA: AIR 2/7193, Document 24B.
720 A.V. Alexander, Letter to Winston Churchill, 20 May 1940, TNA: Premier 3/475/1, p. 66.
721 Bernard Sendall for C.G. Jarrett, Letter to E.A. Seal, 15 June 1940, TNA: Premier 3/475/1, p. 59.
722 Archibald Sinclair, Letter to Winston Churchill, 25 June 1940, TNA: Premier 3/475/1, p. 38.

As with the previous two periods, the British continued to see their future interests generally aligned with the United States or at least sufficiently so that they did not consider the United States likely to pose a future threat to Britain. For example, one official of the British Purchasing Commission in the United States argued in favor of sharing technology with the United States writing, "I am convinced that, while the U.S.A. may not enter this war, she will always remain benevolently neutral and is never likely to enter into war against us within a period of time when most of our developments would be potential weapons for use against us."[723] A.V. Hill made a similar argument in one of the reports he generated on his return from the United States, writing in June 1940, "The United States will certainly not be against us in this, or in any foreseeable war; they may very well come in later on our side; in any case it is entirely in our interest that they should be well prepared."[724] More senior decisionmakers did not dispute these sorts of statements or write about the risk that the Americans might become an enemy in the future.

3. Did the decisionmakers express concerns about the ability of the recipient state to protect technological secrets?

In this period, British concerns about American security measures largely disappeared, with the partial exception of Winston Churchill. As noted in the discussion of the Phony War, while the Air Ministry thought it important that the Americans do everything they could to protect shared secrets, they already believed the Americans could do so. After the invasion of

[723] G.B.A. Baker (British Purchasing Commission), "Exchange of Information with U.S. Authorities," 28 May 1940, TNA: AIR 20/2361.
[724] A.V. Hill, "R.D.F. in Canada and the United States and a proposal for a general interchange of scientific and technical information, and of Service experience, between the Defense Services of Great Britain and those of the United States," 18 June 1940, TNA: AIR 20/2361.

France, the Admiralty dropped its concerns about American security. There are at least five possible reasons for this change.

First, the Admiralty's concerns may always have rested on flimsy foundations – or at least the Admiralty may have been unaware of actual German activity in the United States. While many Admiralty officials seemed confident that anything they told the Americans would quickly leak to the Germans, when pressed for evidence supporting their concerns, they struggled to provide it. After the 3 May interdepartmental conference when the Admiralty was asked to provide a memo with the rationale behind its concerns about American security, it could not. They instead provided two short notes in which senior Admirals wrote of their memories of poor American security years before.[725] Similarly, when Captain Kirk had confronted Admiral Godfrey about British concerns with American security in February 1940, Admiral Godfrey stated directly that he did not have any evidence of poor American security practices.[726] The only specific example ever provided was an American naval officer assigned to the attaché's office in London who after inspecting battle damage on a British ship in October 1939 volunteered to refrain from reporting a problem with German bombs he noticed because he feared it could leak back to the Germans. Interestingly, however, this incident was recorded by Air Ministry rather than Admiralty personnel.[727]

Second, the Admiralty's concerns may have been tempered by the likelihood that the Germans may already have obtained some of the information which was going to be shared with the Americans. First, interrogations of German prisoners captured during the fighting revealed

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[725] Minute by John Godfrey (British Director of Naval Intelligence), 4 May 1940, TNA: AIR 2/7193, Document 13B; Geoffrey Blake [A.C.N.S.(A)], Minute. 4 May 1940, TNA: AIR 2/7193, Document 13C.
[726] Zimmerman, *Top Secret Exchange*, 47.
[727] ACAS(G), Memorandum to S6 - Recommended Changes to Draft "Note on the relative advantages and disadvantages of exchange with the U.S.A. of Information on R.D.F. and other Radio Developments," No Date [May 1940], TNA: AIR 2/7193, Document 19B.

that the Germans were much further along in their use of radio waves to detect aircraft than the British had believed.[728] Additionally, the British had shared much of their technology with the French either just before or after the war began.[729] The rapid retreat of the Allied armies and Fall of France meant that both technical documents and samples of British advanced technology which had been abandoned on the battlefield fell into German hands.[730] The loss of British aircraft equipped with radar related technology behind German lines also occurred.[731] Altogether these changes meant that it would not matter nearly as much if American security was poor because the Germans might already have much of the British information.

Third, it is possible that in the new and dire situation the British faced, the Admiralty was simply willing to discount the risks of potential leakage to the Germans via the United States because the perceived benefits of sharing technology with the Americans now mattered more. While the possibility cannot be discounted, unlike the previous arguments, no specific record of this position exists.

Fourth, German spy activity in the United States actually decreased. June 1940, the same time as the fall of France, also proved a pivotal moment of change for German espionage in the United States. Hitler continued to worry about American intervention in the war and the chance of a spy scandal in the United States. Admiral Canaris had to some extent ignored Ribbentrop's direction to reduce spying in the United States, but on 8 June 1940, in a personal meeting between Canaris and Hitler, Hitler directly told the Admiral to stop all espionage activities in the United States. Canaris directed his network to go dark and moved his head of North American

[728] Minute 25 to VCAS by R. Peck (ACAS(g)), 14 May 1940, TNA: AIR 2/7193.
[729] For example, the British had only shared the secret of R.D.F with the French in the summer of 1939. Zimmerman, *Top Secret Exchange*, 29.
[730] Minute 45 to PS to CAS, 15 June 1940, TNA: AIR 2/7193; Archibald Sinclair, Letter to Winston Churchill, 25 June 1940, TNA: Premier 3/475/1, p. 38.
[731] Minute 25 to VCAS by R. Peck (ACAS(g)), 14 May 1940, TNA: AIR 2/7193.

intelligence to Mexico.[732] While the British may not have known of Hitler's directive, they certainly knew of the other major change in June 1940.

Fifth, the British began their own counterintelligence operations in the United States. On 21 June 1940 William Stephenson arrived in New York to lead an office known as British Security Coordination. Stephenson, who became one of the models for James Bond, became the head of all MI6 operations in the Western Hemisphere. A friend of Winston Churchill, the Prime Minster had personally selected Stephenson over the objections of MI6 leadership to take on the assignment. Stephenson helped convince FDR to create the Office of Strategic Services (OSS) – the forerunner to the CIA – and recommended William Donovan as its head. One of Stephenson's principal missions would be to coordinate with the OSS and the FBI to break German spy rings in the United States (another mission was to plant pro-British propaganda in the United States). Working with the FBI, Stephenson's organization helped break the back of most German espionage in the United States by June 1941, the same month FDR closed all German consulates in the United States.[733]

Stephenson also controlled British censors working in Bermuda. From the first days of the war, the British had sought to examine as much of the correspondence passing between the United States and Europe that touched the island – which was a major way station – as it could. Over a thousand censors examined letters for invisible ink and other trademarks of spy craft. American newspapers caught wind of the British activity in January 1940, and for a time many American ships and aircraft avoided the island, but within a few months they were back. By November 1940, the British reached an agreement with the United States to examine on the

[732] Farago, *Game of the Foxes*, 305.
[733] Farago, 458.

island essentially all incoming and outgoing mail that traveled via the U.S. east coast.[734] This effort not only had helped the British catch German spies in North America, but it also helped them stay confident they would continue to find any they had missed.

Besides the Admiralty, Winston Churchill also wrote specifically about his fear that secrets provided to the Americans would leak to the Germans. No doubt, his opinion was shaped by his time as First Lord and his exposure to the many Admiralty officials who feared lax American security. Unlike the ministries, he was aware of British intelligence activities in the United States. As late as July 18th Churchill still expressed concern about American security, though he attributed this problem not to the inability of the Americans to protect secrets as much as their to lack of wartime controls. He believed American security would increase once the war began.[735] Stephenson's presence in the United States at this time meant Churchill was likely well apprised of the status of American security. It may have been that since collaboration had only just begun, that Churchill was still wary of the current state of security in the United States. His statement may also have been the result of a fit of pique, as Churchill had recognized more than three weeks before that the Fall of France meant that many British secrets had been exposed.[736] Nonetheless, the evidence firmly demonstrates that security concerns had mattered to Churchill, but also that he knew American security was on an improving trajectory.

Single-Period Structural Realism & Technological Capability

This theory would predict that as the British security situation dramatically worsened after the German invasion and defeat of France, both the Air Ministry and the Admiralty should have become much more supportive of technology sharing with the United States, even though it

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[734] "Wartime Spies Who Read the Mail in Bermuda," *Bernews* (blog), October 14, 2019, https://bernews.com/2019/10/wartime-spies-read-mail-bermuda/.
[735] Winston Churchill, Minute to General Ismay, 18 July 1940, TNA: Premier 3/475/1, p. 33.
[736] Winston Churchill, Letter to Lord Beaverbrook (Minister for Aircraft Production), 27 June 1940, TNA: Premier 3/475/1, p. 54.

does not make a precise prediction about the technology sharing policy either of these ministries would adopt. As we have seen, this prediction matches the facts of the case well. Almost day for day the worsening situation in France tracked with an increase in the British support for sharing technology with the United States.

Economic

1. Did the sharing arrangement involve monetary payments to a sharing state?

No. The Tizard Mission's offers did not involve any payment.

2. Did leaders cite economic benefits as an important rationale or haggle over them?

Only once did a British official specifically suggest seeking economic compensation for sharing technology with the United States. In the summer of 1940, Lord Beaverbrook, as head of the Ministry of Aircraft Production, suggested that Britain could sell its technological secrets – either for money or for in kind compensation – to the United States, but his idea never gained traction.[737] Indeed, Beaverbrook soon dropped it himself.[738]

Indeed, a key component of the Tizard Mission's approach was to offer British secrets for free, without bargaining for anything in return. The failure of attempts to haggle over technology (though not for payment) in 1938 and 1939 helped spawn the Tizard Mission. Economic officials were not involved in the mission – though it did receive support from the British Purchasing Commission in the United States.

One could attempt to claim that the British motivation to gain access to American production facilities may have constituted an economic motivation, but the facts do not bear out this possibility. The British were already purchasing military equipment in the United States prior to the Tizard Mission. Until the passage of the Lend-Lease Act in 1941, the American

[737] Lord Beaverbrook, Letter to Winston Churchill, 27 June 1940, TNA: Premier 3/475/1, p. 53.
[738] Minute 76 to ACAS(T) by W.L. Mackenzie, 12 July 1940, TNA: AIR 2/7193.

neutrality laws required the British pay for these purchases with cash. When the British shared their technology with the United States, they did not suggest that the technology itself be counted as payment for future goods, rather they hoped the Americans would produce it for British use. Thus, the British gained no economic compensation for the provision of their technology to the United States.

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

No. British leaders did not discuss the potential of future economic competition with the United States when considering technology sharing during this period. After the Tizard Mission arrived in the United States, British and American officials both worked to subordinate future economic concerns to the security emergency. Specifically, when the issue of adequate patent protection for British technologies with privately held patents arose, officials on both sides of the Atlantic sought to find ways to press forward with technology sharing and production of British technology in the United States while still working out the precise details of patent rights.

A full discussion of the negotiations over patent rights that occurred is beyond the scope of this work, but the two governments spent significant effort working to develop systems to manage patents throughout the course of their wartime collaboration including eventually the Anglo-American agreement for Interchange of Patent Rights, Information, Inventions, Designs for Processes signed on August 24, 1942.[739] Nonetheless, from the earliest days of the Tizard Mission officials working closely on technology exchange pushed for sharing to occur while

[739] "Interchange of Patent Rights, Information, Inventions, Designs of Processes, Agreement between the United States of America and Great Britain," Executive Agreement Series 268, Signed 24 August 1942, Folder: AA-1500 U.S.-U.K. Agreement of 8/24/42; Box 9: Policy and Procedure Files AA-1410 Radar Exchange (Company A/B Plan) January to August 1942 to AA-2320 O.S.R.D. Visitors to Canada 1940-1946 (Box 9); NC-138 Entry 168: Records of the Liaison Office (Entry 168), RG 227, NACP.

patent issues were still being worked out. In late October 1940, Tizard telegraphed to Britain that British and American legal experts on patents had "decided that there was no legal reason why full particulars of equipment disclosed should not be sent immediately to the United States for the Americans to proceed with the manufacture of such material."[740] More than a year and a half later, and still six months before the signing of the patent agreement, an official of the British Supply Council in North America would write, "our own experience, with few exceptions, is that firms here wish to get on with the job and do not wish to be bothered with too much concern about commercial rights or lawyers' letters."[741] If anything, the evidence suggests that once the Tizard Mission occurred, economic concerns were deliberately subjugated to security concerns.

In summary, economic logics do not appear to explain either the transfers that did or did not occur in this phase. When economic and security concerns conflicted, security concerns were consciously prioritized over economic concerns. If anything, the technology that the British provided to the Americans would place Britain at an economic disadvantage after the war because it positioned American firms to be more effective postwar competitors.

Organizational

1. What was the role of military organizations in shaping the sharing decision?

The Air Ministry and Admiralty continued to play important roles in technology sharing policy, though Winston Churchill took more of a direct interest in the subject during this period. Still, the Air Ministry and the Admiralty advocated to him in support of technology sharing. Eventually, the Air Ministry and Admiralty along with General Ismay and the Foreign Office would play important roles in pressuring Winston Churchill to authorize the mission.

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[740] Mr. Butler (Washington), Telegram No. 2359, 20 October 1940, A4419/16/45 TNA: FO 371/24226 p. 171.
[741] William Webster, British Supply Council in North America Letter 193-1-Webster to J.D. Cockcroft, 1 May 1942, TNA: AVIA 7/2796.

2. If military organizations were involved in the decision, were those armed forces operating in close quarters with the potential recipient state's armed forces?

No. The United States was still not in the war. The United States did continue to conduct "neutrality patrols" in the western Atlantic during this period, but these patrols were still not coordinated with the British. The United States had not yet undertaken escorting British convoys as part of these patrols as it would later.

3. What was the role of scientific organizations in shaping the sharing decision?

While independent scientific organizations still did not play an important role in the British technology sharing decisions in this period, the Air Ministry's scientists, and especially Tizard did. During this period, he sought and received the ability to decide what information to share with the United States while he led the mission. For the first time, this put decision-making about technology sharing in the hand of a scientist, though not the decision to send a mission in the first place.

Given these factors, it is difficult to assess what position organizational theory would predict for the Admiralty and the Air Ministry during this period. They both still had significant influence over technology sharing decision making. Neither were yet operating in close association with the United States, and their dire situation vis-à-vis the Germans may have made them want to hold on to their secrets even more than usual. On the one hand, Tizard came to play the key role in the Air Ministry's advocacy for technology sharing. Because he was a scientist, we should expect his SOP to favor openness. As a result, this theory seems to have an ambiguous technology sharing policy prediction for this phase.

From another angle, however, organizational theory seems not to perform very well in this phase. Even if procedures that favor secrecy do not always lead organizations to favor technology sharing, they should at least lead them to resist it – to drag their feet when they can. In this phase, the opposite happened. The Admiralty and the Air Ministry became major supporters of technology sharing. The roadblock was Churchill as Prime Minister, with the organizations pushing him to share. This situation was the exact opposite of what organizational theory would predict.

Table 5-3: Theory Predictions and Actual Values for Technology Sharing After the Blitzkrieg

	TOTT	Structural Realism	Economic	Organizational	Actual Desired	Actual Observed
Admiralty	Specified	Share	None	Ambiguous	TBD	Open
Air Ministry	Open	Share	None	Ambiguous	Open	Open

Conclusion

Table 5-4 displays the combined values for technology sharing policy that TOTT and the alternative explanations predict alongside the actual observed values. The Economic explanation provides constant predictions throughout this case for both the Admiralty and the Air Ministry positions and does not capture the observed variation. Organizational theory does not do much better. It cannot explain the renewed interest in low level technology sharing that developed starting in 1938, even if organizational explanations do not foreclose the possibility of such sharing. It cannot explain why both the Air Ministry and the Admiralty – including uniformed officials– became strong advocates of technology sharing later in the case. TOTT and Structural Realism both capture similar portions of the observed variation because the change in threat is the principal value varying over the period under consideration in both theories. Neither theory perfectly predicts the observed values. TOTT provides more precise predictions than structural realism allowing for more detailed comparisons to actual events. Specifically, TOTT accurately predicts the Air Ministry's position, but underestimates the generosity of the Admiralty's preferred sharing policy. Still, overall TOTT appears to have the predictions that most accurately predict the actual desires of the ministries.

Table 5-4: Theory Predictions and Actual Values for Anglo-American Technology Sharing before and at the start of the Second World War

	TOTT	Structural Realism	Economic	Organizational	Actual Desired	Actual Observed
Pre-War - Admiralty	None	Ambiguous	None	None	Minimal	Minimal
Pre-War - Air Ministry	None	None	None	None	None	None
Failure of Appeasement & Phony War - Admiralty	None	Ambiguous	None	None	Minimal	Minimal
Failure of Appeasement & Phony War - Air Ministry	Specified	Ambiguous	None	None	Specified	Minimal
Blitzkrieg & After - Admiralty	Specified	Share	None	Ambiguous	TBD	Open
Blitzkrieg & After - Air Ministry	Open	Share	None	Ambiguous	Open	Open

Chapter 6
Anglo-American Technology Sharing with the Soviet Union, 1942-1945

Even if we get no information from the Russians it is still … to our advantage to put into the hands of the Russians the means of killing more Germans.
– Representatives of the British Chiefs of Staff, 29 December 1943

Anglo-American technology sharing in the Second World War showed the upper bound of what can occur when two major powers under major threat believe their short- and long-term security interests align. More commonly in history however, major powers have been uncertain or even skeptical of the long-term compatibility of their interests with those of other powers. The case of Anglo-American technology sharing with the third major power that won the Second World War, the Soviet Union, provides a more typical case in which a common threat drives otherwise distrusting states together. One of TOTT's fundamental premises is that national security establishments believe technology sharing can have long-term effects on the balance of power that are difficult to reverse. What happens when a potential long-term security risk from technology sharing collides with an immediate threat? The Soviet case helps answer this question. It shows how states balance the tradeoffs between these short-term goals and long-term risks by developing policies that allow for ongoing technology sharing but controlling more tightly what technology is shared.

Unlike like British and American technological cooperation, technology sharing with the Soviet Union did not begin until well after all three powers were at war with Germany. Even then, when Britain and the Soviet Union made a formal agreement to share technology in the fall of 1942, it took months before the British began considering policy to implement it. Once they did, they approached the Americans for concurrence. So closely had American and British research and development become intertwined, the British felt – and the Americans agreed –

they could not share technology with the Soviets without implicating the other. In part because serious discussions of technology sharing began at the level of the Combined Chiefs of Staff, their centralized authority quickly came to drive technology sharing policy. As a result, this chapter focuses more on the variation between the policies of the United States and Britain than between bureaucratic units within each state's government. Though this collaboration frequently created challenges of its own, both the United States and Britain increased the amount of technology they shared with the Soviets from mid-1943 until the early fall of 1944. As the end of the war in Europe came into sight, both became more hesitant to provide additional developments to the Soviets. Throughout the war both the Americans and the British were particularly hesitant to provide information to the Soviets before they themselves had implemented it on the battlefield fearing Soviet use of the technology could enable the Germans to develop countermeasures before the Western Allies had an opportunity to use it themselves. TOTT explains this pattern of sharing better than any alternative theory, especially when the overall policy of Anglo-American sharing with the Soviet Union is compared with British and American technology sharing with each other during the war.

In the reminder of the chapter: I first review the case for compliance with TOTT's scope conditions. I then provide a history and analysis of British and American technology sharing with the Soviet Union in three sections: prior to the Soviet victory at Stalingrad, from Stalingrad until Allied forces approached the borders of Germany, and the closing phase of the war. In each of these sections, I discuss the evolution of technology sharing policy during the applicable period, categorize the policy, and compare the predictions of TOTT against alternative explanations. Next, I briefly compare the scope and scale of U.S.-British technology sharing with the scope and scale of technology sharing with the Soviet Union. I end with a summary analysis of the case.

Scope Conditions

1. Was the technology sharing that occurred, or was under consideration, government-to-government?

Yes. Both Britain and the United States developed official policies to share technology with the Soviet Union during the Second World War. Examples of private exchange are sometimes mentioned, but do not factor into the analysis unless the private entities involved deliberately sought government approval for their exchange.

2. Was the technology sharing that occurred, or was under consideration, deliberate (i.e. the technology transfer was known to be a likely outcome of the activity under consideration)?

Yes. Technological disclosure discussed below occurred as acts of official policy.

3. Did the technology transfer involve transferring the capability to produce weapons or other items without further support from the sharing state?

This criterion requires slightly more discussion because some evidence suggests that manufacturing information was sometimes excluded from the definition of technical disclosure; however, the bulk of the evidence suggests the opposite. Some early policy recommendations suggested that production information was excluded from technical disclosure. For example, in September 1943 as technology sharing ramped up the Radar Committee of the U.S. Joint Communications Board caveated its recommendations on technical disclosure, writing "'Designs, diagrams and descriptions' of radio transmitting apparatus is defined … to relate to the installation, maintenance and operation of such equipment and in no case includes manufacturing information."[742] Similarly, when offices of the U.S. War and Navy Departments commented on a British proposed list of technology for disclosure to the Soviet Union that same month, the War Department Ordnance office objected to providing detailed production information on items like incendiary shell casings and shaped charges – even though the office would have accepted disclosing drawings of incendiary rounds.[743] These examples suggest willingness to provide technical details needed for use but not production.

Most evidence, however, suggests the technical disclosure polices discussed in this chapter included information useful for developing a capability to produce weapons. In contrast to the U.S. Radar Committee's report in September, the final report of the Radar Committee to the Combined Communications Board on policy for radar disclosure to the Soviet Union from early October 1943 included as a criterion for evaluating information for release, "the desirability of releasing … information on radar techniques which [the Soviets] could not use during the present war due to inability to produce that equipment in time."[744] Even if the document did not explicitly state that it permitted disclosure of production information the inclusion of this caveat shows production information was forefront in the Committee's consideration. Policy on broader technical disclosure was more explicit. A December 1943 report stated it provided general guidance for developing "lists of items of equipment, devices, and weapons, and of

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[742] "Recommendations of the Radio Committee," Enclosure C to G.B. Myers, Note by the Secretary to "Disclosure of Information other than Radar to the U.S.S.R." for the Joint Communications Board, J.C.B. 136/1, 30 September 1943, Folder: 003185-001-0635; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0635&accountid=11752.
[743] Report by the Military Members of the Joint Intelligence Committee," No Date, Attached to A. Sidney Buford, "Disclosure of Technical Information to the U.S.S.R. Reference: C.I.C. 23/D Note by the Secretary," J.I.C. 134/1, 17 September 1943, Folder: Exchange of Information; Box 74 General Secret Files Dispatches (part) – Exchange of Information (Part) (Box 74); Entry UD1 Coordinator of Research and Development General Correspondence, 1941-45 (Entry UD1); Record Group 298 Office of Naval Research (RG 298); NACP.
[744] Radar Committee, Report to the Combined Communication Board "Policy for Disclosure of Radar Equipment and Information to the U.S.S.R," C.C.B. 4/12, 2 October 43, Folder: 003185-001-0600; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0600&accountid=11752

manufacturing processes and designs" for disclosure to Russia.[745] Similar language continued to appear throughout the war in technical disclosure policy documents applicable to both Russia and other states.[746]

In practice, the Americans provided this type of information as well. In June 1944, a War Production Board Official wrote to the U.S. Military Mission in Moscow that the Board's "principle object" in providing radar sets to the Soviets was to "assist them in their technical work."[747] Similarly, an official in the Office of Wartime Economic Affairs noted that the United States has been "increasingly liberal" in providing "industrial 'knowhow' and information relating to operation, servicing, and repair of equipment…in 1943 and 1944."[748]

Moreover, the Americans, and almost certainly the British as well, recognized that Soviets were taking every opportunity to gain technical information. The same Wartime

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745 Report by the U.S. Representatives, Combined Subcommittee, "Disclosure of Technical Information to the U.S.S.R.," No Date, Enclosure to F.B. Royal and A.J McFarland, "Note by the Secretaries," "Disclosure of Technical Information to the U.S.S.R," JCS 527/1, 12 December 1943, Folder: 003185-001-0695; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0695&accountid=11752

746 Report by the U.S. Representatives, Combined Subcommittee, "Disclosure of Technical Information to the U.S.S.R.," Enclosure to Report by the Joint Intelligence Committee, "Release of Equipment and Disclosure of Technical Information to the U.S.S.R.," J.C.S. 527/2, 20 December 1943, Folder: 003185-001-0698; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0698&accountid=11752; U.S. Members, Combined Subcommittee on Disclosure of Technical Information to the U.S.S.R, Report on "Interpretation of U.S. Policy on Disclosure of Technical Information to the U.S.S.R.," 24 January 1944, Enclosure to James S. Lay, Note by the Secretary to "Interpretation of U.S. Policy on Disclosure of Technical Information to the U.S.S.R," J.I.C. 138/10, 25 January 1944, Folder: 003185-001-0717; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0717&accountid=11752; "Basic Principles Governing the Disclosure of Technical Information to Foreign Governments," Appendix to "Disclosure of Technical Information to Foreign Governments, Report by the Joint Intelligence Committee." J.C.S. 927/2, 18 November 1944; Folder: Exchange of Information II, Box 75 Exchange of Information (Part) – Foreign Equipment (Part) (Box 75), Entry UD1, RG 298, NACP.

747 Ray C. Ellis (Director, Radio and Radar Division, War Production Board), Letter to Brigadier General Sidney Spalding (U.S. Military Mission, Moscow), 10 June 1944, Folder: Liaison Office Material, Box 26 Radiation Laboratory Through Liaison Office, London Mission (Box 26); NC-138 Entry 1: Office of the Chairman NDRC & Director OSRD, General Records 1940-77 (Entry 1); RG 227, NACP.

748 "Memorandum by Mr. Auguste Richard of the Office of Wartime Economic Affairs", 17 July 1944; Foreign Relations of the United States, DIPLOMATIC PAPERS, 1944, EUROPE, VOLUME IV eds. E. Ralph Perkins et al. (Washington: Government Printing Office, 1966), Document 993; https://history.state.gov/historicaldocuments/frus1944v04/d993 [accessed 25 March 2021]

Economic Affairs official noted that Soviet "engineers and inspection…had rather free access to war plants producing their Lend-Lease equipment."[749] From this access, the Soviets could gain much technical information. Similarly, the Americans knew the Soviets would often obtain a few models of a given piece of American equipment and then attempt to copy it.[750] Given this recognition even examples of Soviet reverse engineering would qualify as deliberate technology transfer. American policy recognized this situation. For these reasons, a technology had to be authorized for disclosure to the Soviets before it became available through Lend-Lease. Disclosure of the technology, however, did not automatically make large quantities of the equipment available for transfer to the Soviet Union.[751] In summary during the Second World War, the Soviet Union had wide access to large amounts of production and manufacturing information as part of deliberate U.S. and British Government policy.

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[749] "Memorandum by Mr. Auguste Richard of the Office of Wartime Economic Affairs", 17 July 1944; Foreign Relations of the United States, DIPLOMATIC PAPERS, 1944, EUROPE, VOLUME IV eds. E. Ralph Perkins et al. (Washington: Government Printing Office, 1966), Document 993; https://history.state.gov/historicaldocuments/frus1944v04/d993 [accessed 25 March 2021]

[750] Memorandum by Mr. Elbridge Durbrow of the Division of European Affairs*", 8 December 1943; Foreign Relations of the United States*, DIPLOMATIC PAPERS, 1943, THE BRITISH COMMONWEALTH, EASTERN EUROPE, THE FAR EAST, VOLUME III, eds. William M. Franklin and E.R. Perkins (Washington: Government Printing Office, 1963), Document 647; https://history.state.gov/historicaldocuments/frus1943v03/d647 [accessed 25 March 2021]

[751] Enclosure to Report by the Joint Intelligence Committee, "Release of Equipment and Disclosure of Technical Information to the U.S.S.R.," J.C.S. 527/2, 20 December 1943, Folder: 003185-001-0698; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0698&accountid=11752. The policy that technology needed to be cleared for release prior to becoming available for Lend-Lease distribution was nor formally stated until November 1944 in the context of creating a policy for technical disclosure that applied to all the allies, but the policy debates as well discussions at lower levels make clear this requirement was not new. "Basic Principles Governing the Disclosure of Technical Information to Foreign Governments," Appendix to "Disclosure of Technical Information to Foreign Governments, Report by the Joint Intelligence Committee." J.C.S. 927/2, 18 November 1944; Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP. The Supply caveat had was explicitly stated earlier. Draft Message for Commanding General, U.S. Military Mission to the U.S.S.R, Enclosure to James Lay, "Note to the Secretaries," "Disclosure of Technical Information to the U.S.S.R," J.I.C. 138/17, 21 June 1944, Folder: 003185-001-0780; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0780&accountid=11752.

British and American Technology Sharing with the Soviet Union before Stalingrad

Considering British and American attitudes toward the Soviet Union before its invasion by Germany in June 1941, it was not a foregone conclusion that the Soviet Union would receive aid in any form from the Anglo-American powers, let alone technology sharing. Britain and the United States had been suspicious of the Soviet Union from its founding. Both opposed the Bolshevik revolution in 1917 and sent armies to intervene in the Russian Civil War. While the British Government opened trade relations in 1921 and extended the Soviet's full recognition in 1924, it was not to last. Britain cut diplomatic ties in 1927, before a new Labor government reestablished them in 1929. The United States would not recognize the Soviet Union until 1934, the same year the Soviets joined the League of Nations.

Europe's descent into war in the late 1930s convinced both Britain and the United States that the Soviets had aggressive intentions. The Soviets had seemed the stalwart enemies of Nazi Germany. They had supported the Republicans against Franco's Nazi supported Nationalists in Spain, opposed the Munich deal, and refused to recognize Germany's annexation of Czechoslovakia. Thus, the announcement of Molotov-Ribbentrop non-aggression pact between the two dictatorships on 23 August 1939 stunned the world – unbeknownst to the rest of the world the treaty also contained a secret agreement to divide Eastern Europe. Stalin lost little time. On 17 September, he joined in Hitler's invasion of Poland.

Then on 30 November, Stalin invaded Finland. This action caused the League of Nations to expel the Soviet Union for aggression, making it the only state ever to receive such treatment from the League. In June 1940, the Soviets invaded the Baltic States. Just weeks later, the Russians seized parts of Romania. The Soviets also supplied much of the petroleum that the Luftwaffe used to fuel its planes for the Battle of Britain. Both Britain and the United States reacted. The British seriously considered declaring war against the Soviet Union after the invasion of Finland.[752] The United States lumped the Soviet Union in a similar category as Japan. In December 1939, when the State Department announced its "moral embargo" of shipments of aviation equipment and gasoline – including technical information and manufacturing and refining equipment –it applied the decision to both Japan and the Soviet Union.[753] The Americans maintained the policy toward the Soviet Union until January 1941.

Hitler's invasion of the Soviet Union on 22 June 1941 changed everything and nothing. British intelligence had predicted the invasion, and Churchill had attempted to warn Stalin. Thus, the British Prime Minister was unsurprised by Hitler's invasion. Churchill's radio broadcast the evening after the invasion succinctly describe his view:

> No one has been a more consistent opponent of Communism than I have for the last twenty-five years. I will unsay no word that I have spoken about it. But all this fades away before the spectacle which is now unfolding…. We have but one aim and one single, irrevocable purpose. We are resolved to destroy Hitler and every vestige of the Nazi Regime…. Any man or state who fights on against Nazidom with have our aid…. It follows, therefore, that we shall give whatever help we can to Russia and the Russian people.[754]

It did not take long for Churchill to make good on his declaration. Britain and the Soviet Union signed a military alliance against Germany on 12 July. The British soon dispatched supplies via the Arctic as well as two squadrons of Royal Air Force fighters to Soviet bases to protect the convoys.

The Americans sent supplies too. Under the First Soviet Lend Lease Protocol, which began 1 October 1941, the U.S. financed deliveries of British goods to the USSR – though some

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[752] Winston Churchill was a major advocate for this action as First Lord of the Admiralty. It is important to note, however, that the British contemplated supporting the Finns against the Soviets, in part, so they would have the excuse to occupy Norway for use as a supply route to Finland and preempt a German invasion of Norway. Nonetheless, the British would not have considered declaring war against the Soviet Union if they had not already perceived it as hostile.

[753] "The Secretary of State to the Ambassador in the Soviet Union (Steinhardt)", 24 December 1939; Foreign Relations of the United States, The Soviet Union, 1933-1939, eds. E. R. Perkins et al. (Washington: Government Printing Office, 1952), Document 617; https://history.state.gov/historicaldocuments/frus1933-39/d617 [accessed 25 March 2021]

[754] Winston S. Churchill, *The Second World War: The Grand Alliance*, vol. 3 (Boston: Houghton Mifflin Company, 1950), 371–72.

of these "British" goods were manufactured in the United States under British contracts. Aid manufactured in the United States could also flow more easily to Russia via the Pacific. U.S. coordination with the Soviet Union and interest in keeping it in the war only increased after the United States itself joined the fighting in December 1941.

Despite the Anglo-American alliance with the Soviet Union and provision of military aid, technology sharing was virtually non-existent during the first year and a half of the combined war. This situation stands in stark contrast to the technological coordination, introduced in the previous chapter, between Britain and the United States that the Tizard Mission had initiated the year before. This difference is particularly notable given that Britain had sought to provide technology to the United States while it was still neutral, but, at least initially, did not seek to do the same for the Soviets when they were actually engaged in fighting the Germans.

The absence of a wide-ranging policy for technology sharing was not for lack of interest. The Japanese conquest of southeast Asia in late 1941 and early 1942 created rubber shortages for Britain and the United States. The Americans believed the Soviets had made important advances in synthetic rubber technology and sought to exchange information on the subject.[755] The Soviets agreed in principle in February 1942, but no progress occurred until after the September Baruch Report on how the United States could respond to the rubber shortage criticized the lack of coordination with the Russians. In October, Secretary of State Cordell Hull instructed the U.S. Embassy in Moscow to negotiate for the U.S. War Production Board to send a mission to discuss the issue with the Soviets.[756] The mission led by Ernest Pittman of the InterChemical Corporation

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[755] *Cordell Hull, "The Secretary of State to the Second Secretary of Embassy in the Soviet Union*(*Thompson*), *at Moscow", 24 October 1942; Foreign Relations of the United States*, Diplomatic Papers, 1942, Europe, Volume III, eds. G. Bernard Noble and E.R. Perkins (Washington: Government Printing Office, 1961), Document 621; https://history.state.gov/historicaldocuments/frus1942v03/d621 [accessed 25 March 2021]
[756] *Cordell Hull, "The Secretary of State to the Second Secretary of Embassy in the Soviet Union*(*Thompson*), *at Moscow", 24 October 1942; Foreign Relations of the United States*, Diplomatic Papers, 1942, Europe, Volume III,

arrived in Russia in December 1942 and stayed until March 1943, but the Russians provided only very general information and perfunctory tours of rubber plants. As a result, the American mission withdrew the offer to exchange information in late February. It then took five weeks for the mission to receive permission from the Russians to leave. A reciprocal Russian mission arrived in the United States in February 1943. The Russians refused to provide information until given full details on multiple American chemical processes and equipment as well as technical assistance to set up production in Russia. By the time the Russians were finally willing to re-open negotiations with the U.S. government in July, the Americans had already solved most of the technical problems they had faced.[757] Similarly, in December 1942, U.S. Military Mission in Moscow asked for information about tests the Russians had performed on synthetic tires the U.S. had provided but the Russians never provided an answer– almost two years later the U.S. Military Mission just stopped following up.[758]

Interest in Russian information extended beyond rubber. In August 1942, the U.S. Office of Scientific Research and Development received requests from civilian researchers to attempt to gain Russian mathematical papers on fire control.[759] By January 1943, American civilian chemists were also wanting to coordinate with Russians.[760] The same month, U.S. Naval

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eds. G. Bernard Noble and E.R. Perkins (Washington: Government Printing Office, 1961), Document 621; https://history.state.gov/historicaldocuments/frus1942v03/d621 [accessed 25 March 2021]

[757] Exhibit A to "Memorandum by Mr. Auguste Richard of the Office of Wartime Economic Affairs", 17 July 1944; Foreign Relations of the United States, DIPLOMATIC PAPERS, 1944, EUROPE, VOLUME IV eds. E. Ralph Perkins et al. (Washington: Government Printing Office, 1966), Document 993; https://history.state.gov/historicaldocuments/frus1944v04/d993 [accessed 25 March 2021]

[758] Memorandum by the Commanding General, U.S. Military Mission, USSR for the United States Chiefs of Staff, "Present Relations Between the United States Military Mission, Moscow and the Soviet Military Authorities," 22 January 1945, Folder: 003185-002-0183; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-002-0183&accountid=11752.

[759] Warren Weaver, Routing Memo to Liaison Office, 10 August 1942, Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10: Policy and Procedure Files AA-3000 to DD-1300 (Box 10); Entry 168; RG 227, NACP.

[760] M. Calvin (Department of Chemistry, university of California at Berkeley), Letter to C.P. Haskins (OSRD), 15 March 1943, Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10; Entry 168; RG 227, NACP.

intelligence reported that Russians had developed their own radar equipment, which the Americans wanted to inspect.[761] The U.S. Navy also expressed interest in any Russian cold weather batteries.[762] Similarly, the British Royal Society held a conference in the summer of 1942 to discuss liaison between British and Russian scientists, and established an information mechanism for forwarding correspondence between them. This appears to have happened before the official government-to-government agreement, but it is unclear how much correspondence occurred.[763]

The Soviets were clearly interested in British and American technology as well. In July 1942, Andrei Gromyko – future Soviet Ambassador to the United States and later Foreign Minister, then assigned as Counselor at the Soviet Embassy in Washington – requested the OSRD provide as much information as possible on the organization and methods of the U.S. wartime research enterprise as well as any OSRD publications on "metallurgy, machine building, chemistry," strategic resources planning and substitute production.[764] He also wanted copies of the most important reports and agendas of recent scientific conferences. In response, OSRD provided little more than a list of organizations involved in the scientific war effort.[765] Needless to say, technical cooperation made little progress.

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[761] J.J. Downing, Report of the Radar Committee, J.C.B. 53, 26 January 1943, Enclosure D to J.R. Deane and F.B. Royal, Note by the Secretaries to "Disclosure of Radar information to the Russians and Chinese," 215-1 (J.C.S. 223)(Revised), 21 February 1943, Folder: 003185-001-0580; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0580&accountid=11752

[762] Chief of the Bureau of Ships, Letter on the Subject "Interchange of Technical Information with the Russians for Mutual Benefit – Batteries" to the Director, Naval Intelligence; 19 January 1943; Folder: Exchange of Information, Box 74; Entry UD1; RG 298; NACP.

[763] Clipping attached to Weaver's Routing Slip, [Likely from OSRD London Liaison Office bulletin], No Date [August 1942], Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10; Entry 168; RG 227, NACP.

[764] A. Gromyko (Counselor, Soviet Embassy Washington), Letter to J.B. Conant, 3 July 1942; Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10; Entry 168; RG 227, NACP.

[765] Caryl P. Haskins (OSRD Liaison Office), Letter to A. Gromyko, 16 July 1942; Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10; Entry 168; RG 227, NACP.

In August 1942, when Winston Churchill flew to Moscow to meet Stalin for the first time, it seemed this deadlock might change. Churchill travelled to personally deliver to Stalin the message that Britain and the United States would not be able to make a landing in Europe in 1942 and would instead substitute the landings in North Africa. When Churchill delivered the news at their first meeting on August 12th, Stalin was unhappy, but the mood improved throughout the meeting. When the leaders reconvened the next day, the most contentions meeting of the visit occurred. Stalin attacked Churchill and accused the British of being afraid to fight. Churchill responded with what the U.S Ambassador Avril Harriman would later call "the most brilliant" of Churchill's speeches during the war.[766]

In an overlooked moment, Stalin then pivoted the conversation. As Churchill reported, Stalin began a digression on the ability of some Russian trench mortars to fire rockets. Stalin then offered the technology to Churchill, before suggesting the British should return the favor in exchange. Stalin then proposed a general agreement for sharing inventions. In Tizardian fashion, Churchill responded that Britain would "give them everything without any bargaining, except only those devices, which if carried in aeroplanes over the enemy lines and shot down, would make … bombing Germany more difficult."[767] Stalin agreed. Later, Churchill had difficulty understanding Stalin's angry reaction to delay of the Anglo-American invasion of Europe during the second meeting when he had seemed to accept it the first day. Harriman noted that Stalin had previously made similar performances for show. Perhaps, the wily dictator was setting up Churchill to make concessions on technology sharing.

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[766] Quoted in Martin Gilbert, *Road to Victory: Winston S. Churchill 1941-1945* (London: Heinemann, 1986), 186, http://hdl.handle.net/2027/mdp.39015011520338.
[767] Winston S. Churchill, *The Second World War: The Hinge of Fate*, vol. 4 (Boston: Houghton Mifflin Company, 1950), 487.

The simple agreement was negotiated in September and went into effect on 8 October 1942. The two states agreed to "furnish to each other on request all information, including any necessary specifications, plans, etcetera, relating to weapons, devices or processes which at present are, or may in future be, employed … for the prosecution of the war…" They also agreed to share "spontaneously" information about "new weapons devices or process" as appropriate. Either state could decline a request if they stated their reasons.[768] While this agreement seemed on its face as broad as the collaboration between the United States and Britain, it was never implemented with such rigor.

Indeed, it is unclear if this agreement had any immediate effect on Anglo-Soviet technology sharing. Six months later, in mid-March 1943, the British would tell the Americans that no exchange of information had occurred under the Anglo-Soviet agreement up to that point.[769] On the other hand, shortly after concluding the agreement, the British reached out to the United States to coordinate radar technology sharing policy towards the Soviets and the Chinese. This "most secret" technological development appears to have been the only one to receive systematic attention regarding technology sharing with the Soviets prior to spring 1943.

In September 1942, the British developed both criteria to govern the release of radar technology to the Soviets and Chinese as well as specific lists of systems which met those criteria.[770] The British Chiefs of Staff and committees operating under their authority oversaw

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[768] V.M. Molotov, Letter to Archival C. Kerr (British Ambassador in Moscow), 29 September 1942 enclosed in Bennett Archambault, Letter to Vannevar Bush, 23 November 1942; Folder: Archambault Letters to Washington April-Nov 1942; Box 140: History; Entry 176; RG 227, NACP.

[769] "Disclosure of Technical Information to the U.S.S.R, Reference: C.C.S. 75th Mtg, Item 5, Note by the Representatives of the British Chiefs of Staff," C.C.S 187/3, 18 March 1943; Enclosure C to A. Sidney Burford and C.M. Berkeley, "Note by the Secretaries, Combined Intelligence Committee Directive to the Service Members: Disclosure of Technical Information to the U.S.S.R." C.I.C 23/D, 30 March 1943; Folder: Exchange of Information, Box 74; Entry UD1; RG 298; NACP.

[770] F.S. Megnin and T.F Kelly, Note by the Secretaries to Radar Committee, Combined Communications Board, "Disclosure of Radar information to Russia and China," CA/R 9/1, 26 December 1942, Folder: 003185-001-0595;

these developments ensuring inter-service coordination. The British also concluded that given the combined nature of the radar research program, it would be important to coordinate technology sharing policy with the Americans, which, in general, both sides would continue to do for the duration of the war. In part because this international coordination occurred through the structure of the Combined Chiefs of Staff – consisting of the British and American service chiefs or their representatives – and its sub organizations, the Americans similarly coordinated the policy through their Joint Chiefs of Staff and its sub-organizations. This structure continued throughout the war.

The British initially proposed disclosing "full information" on radar equipment using wavelengths of 50 centimeters (cm) or more that was already or about to go into production.[771] Additionally, they would only volunteer information about systems that the Soviets or Chinese had already asked about or might specifically request in the future. They provided the Americans a list of the specific systems about which this policy would entail disclosing information.[772]

The 50 cm rule was an important demarcation. The cavity magnetron – invented in mid-1940 and the most important technology the Tizard Mission had brought to the United States – enabled radars with wavelengths around 10 cm. This new technology had provided several advantages: the equipment required to generate the radar energy and the antennas needed to

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Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0595&accountid=11752.

[771] F.S. Megnin and T.F Kelly, Note by the Secretaries to Radar Committee, Combined Communications Board, "Disclosure of Radar information to Russia and China," CA/R 9/1, 26 December 1942, Folder: 003185-001-0595; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0595&accountid=11752.

[772] F.S. Megnin and T.F Kelly, Note by the Secretaries to Radar Committee, Combined Communications Board, "Disclosure of Radar information to Russia and China," CA/R 9/1, 26 December 1942, Folder: 003185-001-0595; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0595&accountid=11752.

broadcast and receive it were much smaller, lighter, and required less power. These attributes made it easier to install radar systems on ships and aircraft. The smaller wavelengths also enabled more precise systems with finer resolution. As a result, starting in 1940 and 1941 cutting edge production radar systems used by Britain and the United States, as well as research and development, used these smaller wavelengths. Despite the broadness of the agreement to share inventions, the British armed forces were only willing to provide the Soviets technology which was a generation behind.

The Americans imposed more cautious requirements. After generating their own list of technologies which met the British 50 cm rule, the Americans added other restrictions. The Americans did not want to share any technology that used magnetrons or "tubes which may be considered as secret as the magnetron."[773] Additionally, the Americans wanted to restrict information on the new versions of IFF (Identification- Friend, Foe), Mark III and Mark IV, fearing compromise of these "universal" identification systems. Finally, the Americans wanted to withhold some radio navigation technologies (early versions of LORAN) even though they used wavelengths greater than 50 centimeters. The Combined Communications Board, the sub-organizations of the Combined Chiefs of Staff which oversaw radio and radar technologies – approved both the British and American lists on October 14th, 1942 in a document called CCB 4/1.[774] Over the next few months few modifications would occur. The British removed a few versions of air intercept radars – designed to be carried in aircraft to find other aircraft – from the

[773] F.S. Megnin and T.F Kelly, Note by the Secretaries to Radar Committee, Combined Communications Board, "Disclosure of Radar information to Russia and China," CA/R 9/1, 26 December 1942, Folder: 003185-001-0595; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0595&accountid=11752.

[774] F.S. Megnin and T.F. Kelly, Note by the Secretaries to "Disclosure of Radar Information to the Russians and Chinese." C.C.B. 4/3, 30 December 1942, Enclosure G to J.R. Deane and F.B. Royal, Note by the Secretaries to "Disclosure of Radar information to the Russians and Chinese," 215-1 (J.C.S. 223)(Revised), 21 February 1943, Folder: 003185-001-0580; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0580&accountid=11752

list.[775] In December, the British wanted to add IFF Mark III to the disclosure list. The system had entered widespread use, and the Russians knew it existed. the British desired to provide the equipment to Russians for use in their fighters that provided aircover for British Arctic convoys.[776]

Though the Combined Communications Board set coordinated policy for the British and American armed forces, their policy decisions did not always circulate quickly, and the services within both governments still needed to develop their own implementing policies. Thus, when the U.S. Director of Naval Intelligence found out about the policy, he had several recommendations of his own. Because Naval Intelligence believed the Russians had developed some radar equipment of its own, the United States should seek to exchange information with the Russians on radar, rather than simply give them American technology. Specifically, the United States should share all information about radar with the Russians through the U.S. Embassy in Moscow, so it could be tracked, and require a written guarantee from the Russians that they would provide equivalent information in return. After consideration, the Radar Committee of the Joint Communications Board took these recommendations one step further, and on 3 February 1943 recommended arranging for a U.S. radar delegation to go to Russia to exchange information and inspect Russian equipment.[777] This recommendation sparked protest from both

[775] F.S. Megnin and T.F. Kelly, Note by the Secretaries to "Disclosure of Radar Information to the Russians and Chinese." C.C.B. 4/2, 18 November 1942, Enclosure G to J.R. Deane and F.B. Royal, Note by the Secretaries to "Disclosure of Radar information to the Russians and Chinese," 215-1 (J.C.S. 223) (Revised), 21 February 1943, Folder: 003185-001-0580; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0580&accountid=11752

[776] F.S. Megnin and T.F. Kelly, Note by the Secretaries to "Disclosure of Radar Information to the Russians and Chinese." C.C.B. 4/3, 30 December 1942, Enclosure G to J.R. Deane and F.B. Royal, Note by the Secretaries to "Disclosure of Radar information to the Russians and Chinese," 215-1 (J.C.S. 223) (Revised), 21 February 1943, Folder: 003185-001-0580; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0580&accountid=11752

[777] George E. Stratmeyer, (MG, USA, Chief of the Air Staff), Memorandum on the subject "Disclosure of Radar Information to Russia," for the Secretariat, U.S. Joint Chiefs of Staff, 20 February 1943; Enclosure C to J.R. Deane and F.B. Royal, Note by the Secretaries to "Disclosure of Radar information to the Russians and Chinese," 215-1

the U.S. Army and Army Air Forces. Both opposed any non-reciprocal radar exchange with the Soviets. Lieutenant General Joseph McNarney of the Army went further, asserting that the Russians would never agree to such a policy (he proved prescient) therefore opposing any mission. He wanted the United States to provide only that information required for combined operations with the Soviets.[778] The Joint Communications Board said they had no evidence the Russians had developed any radar technology.[779]

The matter went to the Joint Chiefs of Staff in late February. Most opposed the recommendation. Admiral Leahy, President Roosevelt's Chief of Staff – the de facto chairman of the Joint Chiefs, was unwilling to offer the Russians anything unless it was clear the United States would get something in return, and even then, he was skeptical. General McNarney noted he thought it was "naïve" to expect sending a radar delegation to Russia would "accomplish anything."[780] Hap Arnold, head of the Army Air Force, agreed. He noted that the Russians had agreed to exchange information on making long-range weather forecasts, but they had never

(J.C.S. 223)(Revised), 21 February 1943, Folder: 003185-001-0580; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0580&accountid=11752; Joseph T. McNarney (LTG, USA, Deputy Chief of Staff), Memorandum on the subject "Disclosure of Radar Information to Russia," for the Secretariat, U.S. Joint Chiefs of Staff, WCSA 413.68 Russia, 15 February 1943; Enclosure B to J.R. Deane and F.B. Royal, Note by the Secretaries to "Disclosure of Radar information to the Russians and Chinese," 215-1 (J.C.S. 223)(Revised), 21 February 1943, Folder: 003185-001-0580; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0580&accountid=11752

778 Joseph T. McNarney (LTG, USA, Deputy Chief of Staff), Memorandum on the subject "Disclosure of Radar Information to Russia," for the Secretariat, U.S. Joint Chiefs of Staff, WCSA 413.68 Russia, 15 February 1943; Enclosure B to J.R. Deane and F.B. Royal, Note by the Secretaries to "Disclosure of Radar information to the Russians and Chinese," 215-1 (J.C.S. 223)(Revised), 21 February 1943, Folder: 003185-001-0580; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0580&accountid=11752

779 J.J. Downing, Report of the Radar Committee, J.C.B. 53, 26 January 1943, Enclosure D to J.R. Deane and F.B. Royal, Note by the Secretaries to "Disclosure of Radar information to the Russians and Chinese," 215-1 (J.C.S. 223)(Revised), 21 February 1943, Folder: 003185-001-0580; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0580&accountid=11752

780 Minutes from the 63rd Meeting of the Joint Chiefs of Staff, 23 February 1943, Folder: 003181-001-0262; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-001-0262&accountid=11752

actually provided anything of value. Leahy noted this behavior fit a pattern. Representing the Navy, Admiral Horne was the only one to support sharing radar with the Russians. He too insisted any sharing would be on a "quid pro quo basis" and explained that he thought the British had already provided some radar information to the Russians, which would mitigate any risks.[781] In the end, the Chiefs essentially maintained the policy the Combined Communications Board had decided upon. The Russians (and Chinese) could receive information only about radars that were in use and operated on wavelengths greater than 50 cm.[782]

DV

1. Did British and Americans support any sharing of military related technology with the Soviets? If yes, what technology sharing policy did the unit support?

Yes. Both the British and the Americans appear to have pursued minimal technology sharing policies, though the British were more generous to the Soviets than were the Americans. Minimal technology sharing policies involve, one-off, individually negotiated transfers of technology. Those transfers often involve a requirement for reciprocal exchange.

While the British signed an agreement seemingly to engage in open technology transfer with the Soviets, in this period, they did not follow through. When they developed a policy to provide information about radar to the Russians, the British would still only provide information about systems that were cleared for release if the Russians specifically asked for that information or if there were a specific operational requirement to provide it. The British effort to develop a

[781] Minutes from the 63rd Meeting of the Joint Chiefs of Staff, 23 February 1943, Folder: 003181-001-0262; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-001-0262&accountid=11752

[782] Annex to Minutes: Summary of Decisions from the 63rd Meeting of the Joint Chiefs of Staff, 23 February 1943, Folder: 003181-001-0262; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-001-0262&accountid=11752

technology sharing policy led the Americans to do so as well, but the British tended be comfortable providing more information to the Russians than were the Americans. Still, the British were not willing to provide cutting edge radar technology, and do not appear to have arranged official liaison on any research matters. One challenge in evaluating technical sharing in this period is that the British documents provide little information on the scope of the information provided. Sharing information on the capabilities and maintenance of British radar systems is different than the information required to manufacture them. The documents I have found discussing British technology sharing with the Soviets do not provide enough detail in this period to assess which occurred.

The Americans similarly pursed a minimal technology sharing policy with the Soviets. They attempted to exchange information on synthetic rubber, and they eventually followed Britain in developing a policy on the disclosure of radar information, albeit more stringently. Though the Joint Chiefs considered sending a radar mission to Russia, they rejected the idea. The Army, Navy, and Army Air Force all wanted any radar exchange to be reciprocal. The civilian OSRD, on the other hand, made no concrete effort to liaise with the Soviets, even when it received requests from outside scientists to do so.

What do the various candidate theories predict should have occurred in this period?

TOTT

1. What motivations, if any, did decisionmakers have to share technology? Did the sharing state face a severe and immediate threat that it shared with the potential recipient state?

Britain, the United States, and the Soviet Union all shared a severe and immediate threat from Nazi Germany throughout the period under evaluation. For Britain, this threat was more severe than for the United States, from June to December 1941, because the United States was not yet formally at war and throughout the period because of Britain's proximity to Europe. As Churchill described, the common struggle against Nazism was his motivation for alliance with the Soviet Union.

2. How did sharing state decisionmakers assess future interest alignment with the potential recipient state?

Both British and American decision makers were uncertain of the Soviet Union's future intentions and were not convinced their interests would continue to align with Soviet leaders' views of their country's interests. This concern took two forms. First, as already discussed, the Soviets had already shown themselves willing to take advantage of the chaos created by the war and the fall of France to expand their own territory at the expense of neighboring states. Moreover, the Western Allies had evidence to believe that this approach would not change. When British Foreign Minister Anthony Eden went to Moscow in December 1941 to negotiate a treaty of friendship, the Soviets made clear that they expected any such agreement to assure that the Soviet Union's post-war borders would include the territory the Russians had seized in 1940-41. This position was particularly striking considering that at that moment the German army was literally at the gates of Moscow. Soviet insistence on this position continued throughout the war and it remained an issue for both the British and Americans.

Second, the British and Americans were also concerned that the Soviets might make a separate peace with the Germans. This concern would affect both the British and Americans for the first several years of the war. Even in December 1941, as the Soviets finally seemed to slow the German onslaught, the Coordinator of Information – forerunner of the OSS and the CIA – produced an analysis of the potential for a separate Russo-German peace and recommendations to reassure the Soviets of Western support.[783] U.S. Military Intelligence produced a similar analysis again in February 1942, and the OSS would return to the subject in late 1943.[784] A separate peace would have irrefutably demonstrated the divergence of interests between the Soviet Union and the Western Allies, and depending on its terms could have meant the disclosure of British and American technology to the Germans by the Soviets. During this period, British and American decisionmakers saw the future interests potentially diverging from those of the Soviet Union.

3. Did the decisionmakers express concerns about the ability of the recipient state to protect technological secrets?

Yes. While British and American decisionmakers may or may not have worried about German espionage in the Soviet Union during this period, they were concerned that rapidly advancing German forces might capture any technology the Western Allies might provide to the Soviets. Roosevelt had sent Harry Hopkins to Russia in July 1941 because he wanted a first-hand report on the chances of Russian survival before pledging Lend-Lease equipment. The repeated see-saw of German and Soviet advances from 1941 to 1943 made it easy for the Germans to potentially capture any technological information the British or Americans had supplied.

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[783] Office of the Coordinator of Information, East-European Section, "Russia and Germany in Winter and Spring: Allied Policy and a Separate Peace," Special Memorandum No. 6, 23 December 1941 Folder: 003321-001-0003; Office of Strategic Services (OSS)-State Department Intelligence and Research Reports, Part 06: Soviet Union, 1941-1949; Proquest History Vault; https://congressional.proquest.com/histvault?q= 003321-001-0003&accountid=11752.

[784]Military Intelligence Division, War Department General Staff, "Possibility of a Negotiated Russo-German Settlement," I.B. 172, 12 February 1942, Folder: 003342-004-0212; U.S. Military Intelligence Reports: Soviet Union, 1941-1944; Proquest History Vault; https://congressional.proquest.com/histvault?q= 003342-004-0212&accountid=11752. ; Office of Strategic Services, Research and Analysis Branch, "Russia and the Question of a Separate Russo-German Peace," R. & A. No. 1193, 14 September 1943 Folder: 003321-002-0010; Office of Strategic Services (OSS)-State Department Intelligence and Research Reports, Part 06: Soviet Union, 1941-1949; Proquest History Vault; https://congressional.proquest.com/histvault?q= 003321-002-0010&accountid=11752.

This factor affected British and American decisions about the risk involved in providing the Soviets technology. In December 1942, the British Joint Communication Board pointed out that the risk of providing the Soviets information about the details of IFF Mark III was less than actually providing IFF Mark II equipment to the Russians "with the consequent risk of such sets falling into enemy hands."[785] Similarly, in March 1943 Lieutenant General Gordon Macready, who represented the British Army when the Combined Chiefs of Staff met in Washington, expressed concern about the Germans capturing allied technology from the Soviets. In March 1943 he noted that the "reason for non-disclosure [of technical information to the Russians] would be generally one of security." In his only example, he stated, "it would obviously be undesirable to risk on the long land frontiers of Russian employment of secret equipment which was unknown to the enemy."[786] The clear implication is that the length of the Russian front increased the chance of a successful German offensive at some geographic point which could lead to their gaining Anglo-American technology. This rationale was one of the only specific justifications senior military leaders expressly gave for holding backing technology from the Soviets.

The potential for the Germans to militarily defeat the Soviets was a major concern for the British and Americans until after the Soviet victory at Stalingrad. While historians have debated whether Stalingrad ought to be considered *the* turning point of the war against Germany, it is undeniable that the battle had a major effect on the Anglo-American evaluation of the Soviets'

[785] F.S. Megnin and T.F Kelly, Note by the Secretaries to Radar Committee, Combined Communications Board, "Disclosure of Radar information to Russia and China," CA/R 9/1, 26 December 1942, Folder: 003185-001-0595; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0595&accountid=11752.

[786] Minutes of the 76th Meeting of the Combined Chiefs of Staff, 19 March 1943, Folder: 003181-003-0645; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-003-0645&accountid=11752

fighting capability. As the battle raged, in January 1943, General Alan Brooke, Chief of the Imperial General Staff in London, had noted in his diary, “I felt Russia could never hold…. And now! We started 1943 under conditions I would have never dared to hope. Russia has held.”[787] The point remains that before Stalingrad the German army maintained its reputation for invincibility, and to the Western Allies a real risk of Russian defeat existed. This alone led to caution in whether to provide the Soviets with advanced technology which might fall into German hands through capture or Soviet defeat.

Given this combination of factors – severe security threat, concern about the recipient’s future intentions and concern about the security of technology, TOTT would predict a specified technology sharing policy. This prediction is more generous than the minimal technology sharing policy desired by both the British or the Americans in this period or the policy that was implemented. Two factors may help explain this discrepancy. First, TOTT treats the existence of a concern about a potential recipient’s future intentions as equivalent to a concern about its ability to prevent technology from reaching current adversaries. It takes either of these concerns as sufficient to reduce the generosity of a technology sharing policy to “specified.” The existence of both factors in this case likely restricted Anglo-American desires to share technology more. Second, near the end of this period, the Anglo-American technology began to creep closer to a specified policy, specifically with the discussion of an authorized list of radar technology to share with the Soviets. Considering both these factors, even though this case does not perfectly match TOTT’s prediction, the values on the variables still suggest support for TOTT’s underlying theoretical principles.

[787] Quoted in P. M. H. Bell, *Twelve Turning Points of the Second World War* (New Haven, Conn; London: Yale University Press, 2011), 107.

Single-Period Structural Realism & Technological Capability

This theory predicts that states share technology solely to balance current threats. The more severe the threat, the more technology sharing should occur. The only factor which should restrain technology sharing is the recipient's ability to assimilate the technology. In this period, Germany severely threatened the British, Americans, and Soviets. Indeed, the threats the Germans posed to all three was at its peak. Not only should we expect to see technology sharing but given that the British and especially the Soviets were in a dire position, we should expect more liberal technology sharing than at any other point in the war. Thus, this theory might predict that Britain would follow an open technology sharing policy, and the United States, which was slightly less threatened might follow a specified technology sharing policy.

Economic

During this period, Economic factors did not seem to affect the decision to share technology (or not) with the Soviet Union.

1. Did the sharing arrangement involve monetary payments to a sharing state?

The few discussions of sharing that did occur between the United States or Britain and the Soviet Union do not appear to have included discussions of payments by the Russians (other than technological exchange). Both Britain and the United States were providing substantial aid, both in terms of financing and lend lease materials, during the period to support the Russians in the war, so it would have made little sense for them to demand payments for technology from the Soviets in return.

2. Did leaders cite economic benefits as an important rationale or haggle over them?

No. Leaders did not discuss or haggle over economic benefits in discussions of sharing.

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

Concerns over economic competition and patents do not seem to have featured as major factors in considering technology sharing with the Russians during this period. This is likely because little technology sharing was seriously considered. As will be recounted later, discussion of patent issues would arise in future conversations about technology sharing with the Soviets. Given these factors, the Economic alternative explanation would seem to predict that no technology sharing would occur with the Soviets.

Organizational

1. What was the role of military organizations in shaping the sharing decision?

Military organizations played an important role in determining technology sharing policy with Russia in this period. While Winston Churchill and the British Foreign Ministry negotiated the British technology sharing agreement with the Russians, the implementation largely fell to the British Armed Forces. The British Joint Communications Board – a suborganization of the British Chiefs of Staff—, for example, had responsibility for deciding what radar equipment to share with the Soviets. Similarly, though some negotiations took place through the U.S. State Department to arrange possible technical exchange, such as with the War Production Board's effort to exchange information on synthetic rubber production, the U.S. Armed Forces were often involved. The U.S. Military Mission in Moscow also worked to gain information about Russian synthetic rubber practices. Like in Britain, policy on radar sharing policy was also made under the auspices of the American Joint Chiefs of Staff.

2. If military organizations were involved in the decision, were those armed forces operating in close quarters with the potential recipient state's armed forces?

With very limited exceptions, British and American forces were not operating in close quarters with Russian forces, at least not in areas where combat occurred. The major exception in this period was the Arctic convoy routes where British and American ships carried materials to

Russian ports. Near the end of these convoy routes the Anglo-American escorts needed to coordinate with Russian forces.

3. What was the role of scientific organizations in shaping the sharing decision?

In the United States, the Office of Scientific Research and Development had relatively little interest in sharing technology with the Soviets, and resisted calls from both Russian representatives in the United States as well as enquiries from Russian scientists to begin such collaboration. In Britain, the Royal Society did create a mechanism for British and Russian scientists to correspond, but it is unclear what if any exchange took place through the mechanism.

Given these factors, we should expect military organizations to largely follow their SOPs that favor secrecy and avoid sharing technology with the Russians, except in cases when British or American forces were operating in proximity with Soviet forces. This could appropriately be characterized as a minimal technology sharing policy, with the approved one-off technology transfers being in areas of operational readiness. In this period, the British commanded and provided the bulk of the escort forces for convoys headed to the Soviet Union, and so had more frequent combined operations with the Russians. The organizational explanation would therefore expect the British to be more favorable towards sharing with the Russians than the Americans.

The evidence for this period mostly matches these predictions. Technology sharing with Russia by Britain and the United States was minimal. Even General McNarney of the U.S. Army noted that radar could be disclosed to the Soviets without reciprocal exchange when "necessary for combined operations."[788] Similarly, the British sought to add IFF Mark III to the list of

[788] Joseph T. McNarney (LTG, USA, Deputy Chief of Staff), Memorandum on the subject "Disclosure of Radar Information to Russia," for the Secretariat, U.S. Joint Chiefs of Staff, WCSA 413.68 Russia, 15 February 1943; Enclosure B to J.R. Deane and F.B. Royal, Note by the Secretaries to "Disclosure of Radar information to the Russians and Chinese," 215-1 (J.C.S. 223)(Revised), 21 February 1943, Folder: 003185-001-0580; Records of the

technology releasable to the Soviets when they realized it would assist with Arctic Convoys. Still, this explanation does not perfectly fit the data. The British and Americans did become willing to share some technology that did not relate to joint operations, like radar technology operating on wavelengths greater than 50 cm and the attempt to exchange information about synthetic rubber. Nonetheless, the actual policy in this period is relatively like the predictions of the organizational alternative explanation.

The overall predictions of the various explanations as well as the observed values for the technology sharing policies are displayed in Table 6-1. The Organizational explanation is most accurate in explaining the observed technology sharing policies in this case. However, as previously discussed, though TOTT's prediction is not perfect in this case, the factors at work in the period do align with those factors TOTT predicts should matter most. Additionally, TOTT does not account for the simultaneous existence of multiple forms of concern about potential adversaries having future access to shared technology as exist in this case, which could suppress technology sharing further.

Table 6-1: Theory Predictions and Actual Values for Technology Sharing Before Stalingrad

	TOTT	Structural Realism	Economic	Organizational	Observed Desired	Observed Actual
Britain	Specified	Open	None	Minimal	Minimal	Minimal
United States	Specified	Specified	None	Minimal	Minimal	

Technology Sharing with the Soviet Union from Stalingrad to the Frontiers of Germany

Despite both the severe threat from Germany and the Anglo-Soviet agreement on inventions, technology sharing remained tepid through late 1942. This situation began to change

Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0580&accountid=11752

slowly but steadily starting in the Spring of 1943 as the Red Army began to build on its victory at Stalingrad. We have already seen how the first months of 1943 featured the first tentative steps towards the British and Americans creating lists of information cleared for release to the Soviet Union. This process would begin in earnest in March 1943 when the British presented a proposal for a comprehensive technology sharing policy toward the Soviet Union to the Combined Chiefs of Staff. The Spring of 1943 also saw OSRD organize the sole mission it sponsored to Russia to open exchange of medical research information with the Soviet; saw one off technological release – including, significantly, microwave radar –; and by the fall, saw the British and Americans jointly approve a preliminary list of technology for disclosure to the Soviets and a permanent machinery to vet further technological disclosures. Driven in part by American preparations for Operation FRANTIC – the shuttle bombing of Eastern European targets using airbases in Russia – by 1944 the Americans came to push technological disclosure more than the British. Importantly, however, while planning for FRANTIC increased American support for technical disclosure to the Soviets, the major increase of Anglo-American technology disclosure to the Soviets occurred in the Fall of 1943 before the Soviets authorized the FRANTIC mission. This period also saw the final abandonment of any attempts to assure reciprocal technological disclosure from the Russians in exchange for Western technology. By July 1944, the Western Allies had finally approved comprehensive lists of technology for disclosure to the Soviets and a monthly review process to release additional information. The ongoing dedication to coordinating Anglo-American technology sharing policy towards the Soviets, despite some important disagreements, serves as a reminder of how different the British and Americans treated each other as compared to how they treated the Soviets.

The trend of increasing technological disclosure to the Soviets became most obvious on 10 March 1943 when the British informed the Combined Chiefs of Staff of their agreement from the previous Fall to share technology with the Soviets and proposed coordinating disclosure policy.[789] Two days later the Combined Chiefs met to discuss the issue. Though the British had not kept their agreement a secret, the senior American leadership was surprised to learn of its existence and wanted to know more.[790] The British worked to provide more information. The next week on 18 March the British confirmed that they had not yet provided any information to the Russians under the agreement, and the Combined Chiefs agreed that the British would provide the Americans a list proposing technical items (1) to be disclosed to, (2) not disclosed to, and (3) on which information was desired from the Russians. The Combined Intelligence Committee would review these lists. The British and Americans also agreed to continue to coordinate on technical disclosure to the Russians.[791] On 30 March, the British presented a twelve and a half page single-single spaced list of proposed technologies for transfer,

[789] Note by the Representatives of the British Chiefs of Staff to "Disclosure of Technical information to the U.S.S.R," C.C.S. 187, 10 March 1943; Folder: 003185-001-0622; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0622&accountid=11752

[790] Minutes of the 75th Meeting of the Combined Chiefs of Staff, 12 March 1943, Folder: 003181-003-0645; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; Proquest History Vault; https://congressional.proquest.com/histvault?q= 003181-003-0645&accountid=11752
, For previous mentions of knowledge of the sharing agreement by Americans involved research and development see, B.S. Old and James P. Parker, Memorandum on the subject "Exchange of Technical Information with the Russians" to the Coordinator of Research and Development, 30 January 1943; Folder: Exchange of Information, Box 74; Entry UD1; RG 298; NACP.

[791] For confirmation the British had not previously provided any information under their agreement with the Soviets see, Disclosure of Technical Information to the U.S.S.R, Reference: C.C.S. 75th Mtg, Item 5, Note by the Representatives of the British Chiefs of Staff," C.C.S 187/3, 18 March 1943; Enclosure C to A. Sidney Burford and C.M. Berkeley, "Note by the Secretaries, Combined Intelligence Committee Directive to the Service Members: Disclosure of Technical Information to the U.S.S.R." C.I.C 23/D, 30 March 1943; Folder: Exchange of Information, Box 74; Entry UD1; RG 298; NACP. For the decision to coordinate technology sharing, see J.R. Deane and R.D. Coleridge (Secretaries of the Combined Chiefs of Staff), Note to the Secretaries of the Combined Intelligence Committee, Enclosure A to A. Sidney Burford and C.M. Berkeley, "Note by the Secretaries, Combined Intelligence Committee Directive to the Service Members: Disclosure of Technical Information to the U.S.S.R." C.I.C 23/D, 30 March 1943; Folder: Exchange of Information, Box 74; Entry UD1; RG 298; NACP.

withholding, or subjects for inquiry.[792] Some surprising technologies were proposed for transfer including jet propelled aircraft and jet engine units and microwave radar. But even this was unclear, for different sections of the document were contradictory. The Naval section prohibited transferring jet engine technology even though the Air section authorized its disclosure. Similarly, the Naval section prohibited the disclosure of gunnery equipment that used radar gun-laying with 10 cm wavelengths, but the Army section authorized disclosing the C.A. No.1 and No. 2 radars for Coastal Artillery Fire Control, which relied on the same microwave technology and the cavity magnetron.

Both the sheer number of offices with a stake in technology sharing within the War and Navy Departments as well as the discrepancies in the lists meant it would take months to review the lists. The Americans forwarded the British proposal to no fewer than 12 separate offices for comment.[793] The discrepancies ensured extensive comments. Captain Lybrand Smith, the U.S. Navy's Assistant Coordinator for Research and Development, criticized the documents as poor staff work. He called out the contradictions, noted that some of the abbreviations in the document could refer to multiple technical systems, and questioned what would be the policy toward disclosing items that appeared neither on the "to be disclosed" nor on the "not to be disclosed" lists.[794] Other agencies, like the Navy's Bureau of Ordnance (BUORD), had no problem with the British giving away their own technology, but resisted pre-approving any

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[792] See Appendix A to J.R. Deane and R.D. Coleridge (Secretaries of the Combined Chiefs of Staff), Note to the Secretaries of the Combined Intelligence Committee, Enclosure A to A. Sidney Burford and C.M. Berkeley, "Note by the Secretaries, Combined Intelligence Committee Directive to the Service Members: Disclosure of Technical Information to the U.S.S.R." C.I.C 23/D, 30 March 1943; Folder: Exchange of Information, Box 74; Entry UD1; RG 298; NACP.
[793] H.L. Abbot, "Memorandum Re C.I.C 23/D 'Disclosure of Technical Information to the USSR," 19 May 1943; Folder: Exchange of Information, Box 74; Entry UD1; RG 298; NACP.
[794] Lybrand Smith (Assistant Coordinator of Research and Development); Letter on the Subject "Disclosures of Technical Information to the U.S.S.R.," to the Secretary, Joint Intelligence Committee, 21 May 1943; Folder: Exchange of Information, Box 74; Entry UD1; RG 298; NACP.

potential technology transfer of BUORD controlled items. BUORD also resisted the idea of offering the Soviets any technology they had not already asked for and the requirement to provide reasons if it recommended denying Soviet requests.[795] The British proposal to approve specific lists of technologies for disclosure to the Russians stalled as it became bound up in the bureaucratic morass.

This setback, however, did not stop the trend towards increased technology sharing with the Soviets. While still awaiting a full American response on the British comprehensive proposal in May 1943, the Combined Communications Board (CCB) approved providing the Soviets "full technical details" of the G.L. Mark III.[796] Also known as the A.A. No. 3, this system used microwave radar generated by a cavity magnetron to provide fire control for anti-aircraft guns and had offered large improvements in accuracy. The Russians received the information on 24 May, and just a few days later asked for two C.A. No. 1 Mark II radars, which had been on the list of technology the British had proposed to disclose. This time the CCB delayed until August before pushing the issue to Combined Chiefs. By that time the Soviets had made more extensive requests of the Americans for at least 13 different models of radar equipment.[797] Of the thirteen

[795] W. H. P. Blandy (Chief of the Bureau of Ordnance), Letter on the Subject "Disclosure of Technical Information to the U.S.S.R." to the Joint Chiefs of Staff (Joint Intelligence Committee), 22 April 1943; Folder: Exchange of Information, Box 74; Entry UD1; RG 298; NACP.

[796] Combined Communications Board, Report to the Combined Chiefs of Staff "Release of Radar Information and Equipment to the U.S.S.R.," C.C.S. 302, 8 August 1943, Folder: 003185-001-0577; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0577&accountid=11752.

[797] George Olmstead (Chief, Requirements & Assignments Branch, International Aid Division), Memorandum on the Subject: "Release of Radar Equipment to U.S.S.R" for the Joint communications Board, 31 August 1943 Enclosure to Joint Radar Committee, Report on "Release of Specific items of Radar Equipment and Information to the U.S.S.R," J.C.B. 53/2, 9 September 1943, Folder: 003185-001-0608; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0608&accountid=11752.

systems, and consistent with CCB 4/1, the request for all three systems that employed wavelengths less than 50 cm were denied.[798]

Frustrated by the American's delays, the British raised the issue at a higher level. After the Quadrant Conference at Quebec in mid-August 1943, Churchill raised the issue of technical disclosure to the Russians directly with Roosevelt.[799] The attention did the trick. At their meeting on 17 September, the Combined Chiefs of Staff agreed to support technology sharing with the Soviets and re-directed the Combined Intelligence Committee to develop lists of technologies that should or should not be shared with the Russians, or about which there was doubt.[800] The next-day, 18 September, the same list the British had offered in March was re-distributed for comment with a requirement to respond within three days.[801]

The urgency meant that on 1 October, a preliminary list of technologies authorized for disclosure to the Russians was ready. It authorized the release of some new electronic equipment and radars that had been previously denied. While it contained a few systems that used cavity magnetrons, most remained off limits. For the first time, this list included an approved list of

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[798] F.R. Furth, Acting Chairman, Joint Radar Committee, Report on "Release of Specific items of Radar Equipment and Information to the U.S.S.R," J.C.B. 53/2, 9 September 1943, Folder: 003185-001-0608; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0608&accountid=11752.

[799] "Memorandum by the Representatives of the British Chiefs of Staff," "Disclosure of Technical Information to U.S.S.R." C.C.S. 187/5, 29 December 1943, Folder: 003185-001-0702; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0702&accountid=11752

[800] Joint Intelligence Committee, Report to the Joint Chiefs of Staff, "Disclosure of Technical Information to the U.S.S.R." J.C.S. 527, 11 October 1943, Folder: 003185-001-0662; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-06625&accountid=11752.

[801] H. Redman and J.R. Dean (Combined Secretariat), "Memorandum for the Combined Intelligence Committee Subject Exchange of Technical Information with the U.S.S.R.," 18 September 1943; Folder: Exchange of Information; Box 74; Entry UD1; RG 298, NACP. Though many Navy offices responded within this timeline in response to a verbal request, the U.S. Navy did not actually re-forward the British list form March list for comment to its subordinate commands until 29 September, though it too required a response in four days (which included a weekend). R.E. Schuirmann, Memorandum on the Subject "Disclosure of Information to the U.S.S.R" from the Vice Chief of Naval Operations to the Chiefs of the Bureaus of Ships, Ordnance, and Aeronautics; the Coordinator of Research and Development; and the Director, Naval Communications; 29 September 1943; Folder: Exchange of Information; Box 74; Entry UD1; RG 298,

non-electronic equipment for release to the Soviets. It was often generous. While jet engine technology was explicitly prohibited it authorized significant other aviation information – including details on all internal combustion aviation engines except for Rolls Royce two stroke units. In total the list was four pages long. But the list was still preliminary. Two separate lists totaling seven pages listed the equipment proposed for disclosure on which the Combined Intelligence Committee still awaited approval from either the British or the U.S. Navy. The Committee, however, still recommended that disclosure of information to the Soviets proceed based on mutual exchange.[802] The next day the Combined Communications Board loosened its guidance too. In addition to listing equipment explicitly authorized for approval, it also revised its broader guidance on the types of systems about which it prohibited providing information to the Russians. In addition to including developing items like proximity fuses, and radar bombsights, it revised guidance on radar wavelengths. Now only radars that operated on wavelengths of 8 cm or less were expressly prohibited from the Soviets.[803] This list marked a key turning point. For the first time the British and Americans had agreed on a broad list of technologies releasable to the Soviet Union. From this moment on technical disclosure could occur far more easily and without repeated specific requests requiring high level approval.

More importantly, the lengthy, though only partially complete, effort to vet the British list led to the first recommendations to establish a mechanism within both the U.S. Joint and the Combined Chiefs of Staff run by staff with the expertise required to manage disclosures of

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[802] Combined Intelligence Committee, Interim Report to the Combined Chiefs of Staff on "Exchange of Technical Information with the U.S.S.R," C.C.S. 187/2, 1 October 1943, Folder: 003185-001-0644; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0644&accountid=11752 – "preliminary provisional report."

[803] Radar Committee, Report to the Combined Communication Board "Policy for Disclosure of Radar Equipment and Information to the U.S.S.R," C.C.B. 4/12, 2 October 43, Folder: 003185-001-0600; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0600&accountid=11752

technical information to the Soviets and other allies.[804] As a result, on 15 October both at the U.S. level and the Combined level, the Chiefs of Staff established a Technical Information Disclosure Sub-Committee to their respective intelligence committees.[805] These committees soon produced the first overarching guidance of what could and could not be released to the Soviets.

In a few days before Christmas, the American Joint Intelligence Committee, in coordination with the Joint Communications Board, produced a "basic policy" for technical disclosure to the Soviets.[806] The USSR could receive (1) any information classified less than U.S. "Restricted,' (2) "technical information concerning equipment, weapons, devices, manufacturing process or designs intended for use by or from the U.S.S.R. which are in production, field test or are standard authorized equipment," (3) information about the maintenance or improvement of equipment the Soviets already had. Along with these broad criteria for release, the policy also specifically prohibited sharing any experimental or research and development work or anything else the Joint or Combined Chiefs of staff expressly prohibited.[807] Importantly, the policy was still supposedly contingent on the Soviets providing reciprocal information. This basic policy, with a few changes and some clarification, would remain intact for the duration of the war.

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[804] Memorandum by the Representatives of the British Chiefs of Staff, "Disclosure of Technical Information to the U.S.S.R.," C.C.S. 187/3, 8 October 1943; Folder: 003185-001-0661; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0661&accountid=11752.

[805] Minutes to the 123rd Meeting of the Combined Chiefs of Staff, 15 October 1943, Folder: 003181-003-0158; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; Proquest History Vault; https://congressional.proquest.com/histvault?q= 003181-003-0158&accountid=11752.

[806] Report by the Joint Intelligence Committee, "Release of Equipment and Disclosure of Technical Information to the U.S.S.R.," J.C.S. 527/2, 20 December 1943, Folder: 003185-001-0698; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0698&accountid=11752.

[807] Report by the Joint Intelligence Committee, "Release of Equipment and Disclosure of Technical Information to the U.S.S.R.," J.C.S. 527/2, 20 December 1943, Folder: 003185-001-0698; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0698&accountid=11752.

The civilian agencies of the U.S. Government became more comfortable sharing information with the Soviets as well. In the Spring of 1943, the Soviets proposed to the U.S. State Department an exchange of medical research. This research fell under the auspices of OSRD, and the State Department passed on the request, which OSRD eagerly accepted. Vannevar Bush, who led the civilian research agency, continued to take his cue on technology sharing from the War and Navy Departments, so before proceeding he requested approval from both. They agreed so long as their respective intelligence offices would have the opportunity to review any material before it was provided to the Soviets.[808] As it happened, the U.S Army Medical Corps was also trying to find a way to exchange information at the same time.[809] So were civilian academics, who were in the process of creating a new journal, the American Review of Soviet Medicine.[810]

The task of organizing the exchange fell to the Committee of Medical Research – one of two committees which oversaw research at OSRD. By July 1943, the effort was in full swing. The Committee selected medical topics on which it thought exchange would be most beneficial and had papers prepared. As research continued to be coordinated, they also sought the review of British and Canadian officials. Hoping to potentially open a broader exchange with the Russians, the Committee also undertook to send a mission to the Soviet Union to engage in exchange rather than just supply the completed papers.[811] Indeed, Bush hoped the medical mission might be "the first step in the creation of a more comprehensive exchange plan consistent with

[808] James B. Conant (Acting Director, OSRD), Letter to C.J. MacKenzie (National Research Council, Canada), 14 July 1943; Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10; Entry 168; RG 227, NACP.
[809] William A. Shurcliff, Memorandum on the Subject "Notes on Russian Technical Liaison," to Carroll L. Wilson, 13 July 1943; Folder:BB-2100 Establishment and Basic Policy; Box 10; Entry 168; RG227, NACP.
[810] William A. Shurcliff, Memorandum on the Subject "Notes on Russian Technical Liaison," to Carroll L. Wilson, 13 July 1943; Folder:BB-2100 Establishment and Basic Policy; Box 10; Entry 168; RG227, NACP.
[811] Carroll L. Wilson, Letter to Vannevar Bush, 14 July 1943; Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10; Entry 168; RG 227, NACP.

effecting [sic] interchange between [the United States], Canada and Great Britain."[812] Though only the British would end up participating, both the British and Canadians were invited to join this mission.[813]

As frequently happened with the Soviets, however, delays occurred. In Mid-October, the papers were prepared and had been reviewed for months and the Americans had selected a leader for the medical mission Dr. A.B. Hastings, but the Soviets had not cleared the mission. Bush asked the State Department to follow up.[814] He was particularly concerned that the research prepared for exchange was becoming stale. He hoped the mission would be able to travel by mid-November. Still progress was slow. The mission would not arrive in Moscow until 14 January to begin its month long stay in the Soviet Union.[815] The mission did lead to the exchange of some medical publications. In May 1944, Bush received permission from the Joint Intelligence Committee to send OSRD medical research reports to the Soviets so long as they met a modified version of the criteria established to disclose technical information.[816] Nonetheless, Hastings's mission was the only one OSRD sponsored to Russia during the war[817]

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[812] Vannevar Bush, Letter to C.J. Mackenzie (President of National Research Council of Canada), 1 November 1943; Folder: Cooperation – Canada; Box 29: Cooperation: CWS-NRRC Technical Committee (1943) to Coordinator of Inter-American Affairs (Box 29); NC-138 Entry 13 Records of the Administrative Office, General Records OSRD (Entry 13); RG 227, NACP.
[813] Vannevar Bush, Letter to C.J. Mackenzie (President of National Research Council of Canada), 1 November 1943; Folder: Cooperation – Canada; Box 29; Entry 13; RG 227, NACP. By cable asked Brits to send comments before mission left, had Canadian comments.
[814] Vannevar Bush, Letter to Dean Acheson (Assistant Secretary of State), 11 October 1943; Folder: Liaison, Russian Medical; Box 6; NC-138 Entry 7 Office of the Historian. 1943-1946. Subject Files (Entry 7); RG 227; NACP.
[815] A. Baird Hastings and Michael B. Shimkin, "Medical Research Mission to the Soviet Union," *Science* 103, no. 2681 (May 17, 1946): 605–8, https://doi.org/10.1126/science.103.2681.605.
[816] Appendix B to "Report by the U.S. Members, Combined Subcommittee on Disclosure of Technical Information," "Exchange of Medical Information with the U.S.S.R.," J.I.C. 138/13, 31 May 1944, Folder: 003185-001-0752; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0752&accountid=11752.
[817] William W. Eaton, Memorandum on the subject "Medical Journals for Russia" to Shirley Blackistone, 19 May 1944, Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10; Entry 168; RG 227, NACP. The Russians did send a reciprocal Mission to the United States in late 1944. Carroll Wilson, Memorandum regarding "Disclosure of Technical information to the U.S.S.R." to Dr. F.S. Cooper, 7 August 1944; Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10; Entry 168; RG 227, NACP.

Indeed, medical research was the only case of research and development exchange with the Soviets.[818]

The desired British technology sharing policy with the Soviets remained more generous than the Americans' even as the British began to regret the breadth of their technology sharing agreement with the Russians. While both the British and Americans had long understood it would be difficult to get technology information from the Russians, by 1943, the British had concluded that should no longer stop them from providing technology to them.[819] In response to the American proposal to make technology disclosure contingent on Russian reciprocity, the British responded on 29 December 1943 that they thought such a policy would "lead to delay and friction." More importantly, they argued "even if we get no information from the Russians it is still … to our advantage to put into the hands of the Russians the means of killing more Germans."[820] Here the British identified the fundamental realist motivation for technology sharing, but it would take a few more months before the Americans would officially agree.

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[818] "Memorandum by Mr. Auguste Richard of the Office of Wartime Economic Affairs", 17 July 1944; Foreign Relations of the United States, DIPLOMATIC PAPERS, 1944, EUROPE, VOLUME IV eds. E. Ralph Perkins et al. (Washington: Government Printing Office, 1966), Document 993; https://history.state.gov/historicaldocuments/frus1944v04/d993 [accessed 25 March 2021]; Eugene W. Scott (Assistant Liaison Officer, OSRD), Letter to Homer Jones (Director, Clearing Office for Foreign Transactions and Reports, Foreign Economic Administration), 15 March 1945, Folder AA-1220 Distribution of OSRD Reports 1940-1946; Box 1: Policy and Procedure Files (Box 1); Entry 168; RG 227; NACP.

[819] George Marshall had noted more than a year before that he thought the Russians would never release any of their own technology as part of an exchange and attempt to do so would likely worsen relations. Minutes from the 63rd Meeting of the Joint Chiefs of Staff, 23 February 1943, Folder: 003181-001-0262; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-001-0262&accountid=11752. Marshall proved correct. In one example, the U.S. Navy spent most of 1943 trying to get information on cold weather batteries and cold weather design and operation of lubricating and hydraulic systems from the Russians without success. At one point, the Navy Research and Development Office suggested making part of lend lease aid contingent on suppling the information. Lybrand Smith (Assist Coordinator of Research and Devilment); Letter on the Subject "Exchange of Technical Information to the U.S.S.R.," to Director of Naval Intelligence, 25 May 1943; Folder: Exchange of Information, Box 74; Entry UD1; RG 298; NACP.

[820] Memorandum by the Representatives of the British Chiefs of Staff," "Disclosure of Technical Information to U.S.S.R." C.C.S. 187/5, 29 December 1943, Folder: 003185-001-0702; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0702&accountid=11752.

Ironically, the British pushback on reciprocity came as part of an effort to walk back the commitment they had previously made to share technology with the Russians. At the same time, the very end of the December, the British proposed to replace the Anglo-Soviet Technology Agreement with a triparty Anglo-American-Soviet agreement.[821] Though the British suggested many potential advantages – all of which the Americans quickly saw through – the principal reason the British suggested a new agreement was the problematic "escape clause" in the original agreement.[822] If the British wanted to deny a Soviet request for information, they needed to provide a reason. Sometimes that reason was that the Americans had not yet cleared information, other times it was that the British did not want to share the information, but neither of these were politic. So instead of issuing outright denials, the British would just keep requests forever under review. The new agreement the British proposed included three broad reasons why a party could withhold information, and a government seeking to deny a request only needed to state it fit one of those reasons. Packaging the new treaty as a triparty agreement allowed the British to plausibly deny that they were deliberately walking back their agreement with the Soviets. The Americans, however, had no interest in signing a technology sharing agreement with the Russians even though they were about to take over as the driving force behind technology

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[821] "Memorandum by the Representatives of the British Chiefs of Staff," "Disclosure of Technical Information to U.S.S.R." C.C.S. 187/5, 29 December 1943, Folder: 003185-001-0702; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0702&accountid=11752.

[822] "Memorandum by the U.S. Members, Combined Intelligence Committee," "Disclosure of Technical Information to the U.S.S.R.," C.I.C. 23/9, 21 January 1944, Folder: 003185-001-0715; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0715&accountid=11752. "Memorandum by the British Members, Combined Intelligence Committee," "Disclosure of Technical Information to the U.S.S.R," C.I.C. 23/10, 28 January 1944, Folder: 003185-001-0721; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0721&accountid=11752; Memorandum by Mr. Elbridge Durbrow of the Division of European Affairs*", 23 December 1943; Foreign Relations of the United States*, DIPLOMATIC PAPERS, 1943, THE BRITISH COMMONWEALTH, EASTERN EUROPE, THE FAR EAST, VOLUME III, eds. William M. Franklin and E.R. Perkins (Washington: Government Printing Office, 1963), Document 643; https://history.state.gov/historicaldocuments/frus1943v03/d648 [accessed 25 March 2021]

sharing from the British. The Combined Chiefs of Staff were never able to come to an agreement on the issue, and in February 1944 the Americans simply left the British hanging.[823] As for the bind the British found themselves in regarding their earlier agreement, by mid-1944 they made a deliberate policy to stop making any mention of the arrangement to the Soviets.[824]

Though Fall 1943 marked the moment when the Americans had come to support increased disclosure to the Soviets, February 1944 marked the moment when the Americans began to push technical disclosure to the Soviets more than the British. As the American bombing campaign against Germany had grown during 1943, the U.S. Army Air Force developed an interest in establishing bases in the Soviet Union to use in shuttle bombing German-occupied Europe. To the Americans the proposal offered several advantages. The U.S. Air Forces would be able to attack anywhere in Europe, adding targets and forcing the Germans to distribute their air defenses over a greater area. They would be able to launch raids on days the weather in England or Italy would not support landings but the weather in Russia would. Additionally, working out systems of Russo-American coordination for shuttle bombing Germany would increase the chances the United States would be able to bomb Japan from the Soviet Far East once the Russians entered the Pacific War.[825]

The Americans first raised the proposal with the Soviets at the Moscow Conference in October 1943.[826] Roosevelt again raised the issue with Stalin directly at Tehran. Stalin finally

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[823] H. Redman and F.B. Royal, "Note by the Secretaries," "Disclosure of Technical Information to the U.S.S.R." C.C.S. 187/6, 12 February 1944, Folder: 003185-001-0732; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0732&accountid=11752.

[824] "Memorandum by the Representatives of the British Chiefs of Staff," "Disclosure of Technical Information to the U.S.S.R.," C.C.S. 187/12, 11 July 1944, Folder: 003185-001-0815; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0815&accountid=11752.

[825] John R. Deane, *The Strange Alliance; the Story of Our Efforts at Wartime Cooperation with Russia* (New York: Viking Press, 1947), 107.

[826] Deane, 20.

granted his assent to the operation on 2 February 1944. This would be the first (and one of the only) combined Soviet-American military operations of war. The Americans wanted to commence shuttle bombing, codenamed Operation FRANTIC, as soon as the spring weather allowed. While the U.S. Military Mission in Moscow got to work arranging all the coordination necessary to bring American support crews to the Soviet Union and build the required air bases, in Washington, the Army Air Force needed to make sure any technology it would use on the ground or on aircraft operating from Russia was approved for disclosure to the Soviets.

The issue came to a head at the end of May. On May 4th, 1944, the Combined Intelligence Committee, after more than a year's work, had at last completed its final lists of technology authorized for release to the Soviets. Before the British and Americans could act on these lists, however, the British in Washington needed approval from London, which was slow to come. The U.S. Army Air Force was planning to launch its first shuttle bombing mission on 1 June – it would occur one day later – and time was running short.[827]

Then a crisis came. On 25 May members of the U.S. Military Mission to Moscow along with the U.S. Ambassador to the Soviet Union Avril Harriman met with U.S. Army Air Force commanders in London. The Military Mission was told that any equipment in operation could be released to the Russians.[828] But two problems arose. First, this guidance omitted the requirement that only technology currently in use *and* designated for use by or from the Soviet Union could be released. The second part of the requirement had been omitted from the guidance. Second, and more importantly, the bombers intended for the first FRANTIC mission carried the most

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[827] Deane, 117–18.

[828] "Report by the Joint Intelligence Committee," "Disclosure of Technical Information to the U.S.S.R.," J.C.S. 527/6, 3 June 1944, Folder: 003185-001-0758; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0758&accountid=11752

advanced version of the radar bombsight.[829] Known as both the AN/APS-15 and H2X, the bombsight used an X-band radar with 3 cm wavelength to provide much more detailed information than its longer wavelength predecessors, and the proposed lists submitted on 4 May still recommended against disclosing X-band radars to the Soviets. The general guidance on what could and could not be disclosed to the Russians conflicted with the specific equipment identified for release. Upon learning of the confusion, General Hap Arnold, commander of the Army Air Force, put a hold on information disclosure to the Russians, but the issue needed resolution.[830]

To the Americans two issues had caused the confusion and near release of X-band radar to the Soviets. First, confusion existed in American policy. Resolution was straightforward. Responsibilities needed clarification. American theater commanders and the Military Mission in Moscow had insufficient understanding of U.S. policy regarding the release of technology to the Soviets. Washington needed to provide better guidance and reiterate that, unless specifically approved by the Combined Chiefs of Staff, no technical information classified confidential or above could be released to the Soviets. This clarification simply required a message to all concerned commanders.[831]

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[829] "Further Facts Bearing on the Problem," Appendix A to "Report by the Joint Intelligence Committee," "Disclosure of Technical Information to the U.S.S.R.," J.C.S. 527/6, 3 June 1944, Folder: 003185-001-0758; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0758&accountid=11752
[830] Report by the Joint Intelligence Committee," "Disclosure of Technical Information to the U.S.S.R.," J.C.S. 527/6, 3 June 1944, Folder: 003185-001-0758; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0758&accountid=11752
[831] Draft Instructions to the U.S. Services, Theater Commanders, and the U.S. Military Mission Moscow," Appendix B to "Report by the Joint Intelligence Committee," "Disclosure of Technical Information to the U.S.S.R.," J.C.S. 527/6, 3 June 1944, Folder: 003185-001-0758; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0758&accountid=11752

The second issue was Anglo-American coordination, or lack thereof. Part of the confusion arose from the lack of specific, approved lists of technologies authorized for disclosure. From the American perspective, the lengthy back and forth that had created this problem was the fault of the British – something the British did not try to deny. The British still had not responded to American proposals made in February 1944. U.S. representatives had gotten the Combined Intelligence Committee to create an "emergency procedure" for approving technical disclosure to the Soviets in March, but it had not solved the problem.[832] In June, the continued British delay was now hampering the American relationship with the Soviet Union and the combined war effort. Some even thought the British were using the delay to build an advantage in their relations with the Soviets vis-à-vis the United States. The Joint Intelligence Committee concluded that agreeing on a "combined list and combined procedure" for disclosure to the Soviets was "impossible."[833] When presented with the position, the British on the Combined Intelligence Committee did not object to unilateral American disclosure. As a result, on 20 June, the American members of the Combined Chiefs of Staff informed the British that "military necessity… in connection with current shuttle bombing operations from Russian bases" required the United States to unilaterally disclose classified technical information to the Soviets.[834] The next day the U.S. Joint Intelligence Committee provided a nine page list of

[832] "Report by the Joint Intelligence Committee, "Disclosure of Technical Information to the U.S.S.R," J.C.S. 527/7, 11 June 1944, Folder: 003185-001-767; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0767&accountid=11752.
[833] "Report by the Joint Intelligence Committee, "Disclosure of Technical Information to the U.S.S.R," J.C.S. 527/7, 11 June 1944, Folder: 003185-001-767; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0767&accountid=11752.
[834] Memorandum by the United States Chiefs of Staff, "Disclosure of Technical Information to the U.S.S.R.," C.C.S. 187/8, 20 June 1944, Folder: 003185-001-0775; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0775&accountid=11752

systems it recommended for disclosure to the Russians.[835] It was full of microwave radars (though none that operated on the X-band or shorter wavelengths). It also authorized the disclosure of previously forbidden magnetic anomaly detectors.

Whether it was the intention or not, the American demarche convinced the British to speed up their coordination process for technical disclosure to the Soviet Union. They quickly acknowledged the U.S Army Air Force would release all technology carried on the bombers used in shuttle bombing except H2X and raised no objections, but they requested the Americans hold any further action on disclosure for a week.[836] The Americans complied.[837] The British soon proposed a simple standard: If the item was involved in U.S. operations from Russian bases or would help the Russians kill Germans before the end of the war, disclose it. If, for whatever reason, the item would not help the Russians kill more Germans "within a reasonable period of time," it should be withheld.[838] The Americans seized on this rule to prevent delay. They declared that everything on their disclosure list met the "kill Germans" standard, and thus the British and Americans agreed. The Americans also provided their list.[839] The same day, Independence Day 1944 as it happened, the Joint Chiefs of Staff finally forwarded the list of

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[835] James Lay, "Note to the Secretaries," "Disclosure of Technical Information to the U.S.S.R," J.I.C. 138/17, 21 June 1944, Folder: 003185-001-0780; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0780&accountid=11752.
[836] "Memorandum by the Representatives of the British Chiefs of Staff," "Disclosure of Technical Information to the U.S.S.R.," C.C.S. 187/9, 24 June 1944, "Folder: 003185-001-0792; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0792&accountid=11752.
[837] Joint Intelligence Committee, Report on "Disclosure of Technical Information to the U.S.S.R," J.C.S. 527/8, 29 June 1944, Folder: 003185-001-0793; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0793&accountid=11752.
[838] Joint Intelligence Committee, Report on "Disclosure of Technical Information to the U.S.S.R," J.C.S. 527/8, 29 June 1944, Folder: 003185-001-0793; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0793&accountid=11752.
[839] Memorandum by the United States Chiefs of Staff," "Disclosure of Technical Information to the U.S.S.R," C.C.S. 187/11, 4 July 1944, Folder: 003185-001-0800; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0800&accountid=11752.

technologies authorized for disclosure to the U.S. Military Mission in Moscow.[840] General Deane, commanding the mission, was authorized to provide the list to the Russians at his discretion, but actual disclosure would occur to Soviet representatives in the United States. Deliberately, Deane's instructions said nothing about requiring reciprocity.[841]

The British, recognizing their waning influence, sought to keep what they could. Like the Americans had done, they forwarded the list of information they proposed to disclose – which was unchanged since May with the exception of adding penicillin – as well as the policy they established for their mission in Moscow.[842] The British wanted to avoid both bargaining and wholesale disclosure, preferring to have the Russians ask for information, but also instructed their representative to coordinate closely with Deane.[843] The Americans were clearly in the driver's seat. Knowing both countries' lists would need future updating, the British proposed the Combined Intelligence Committee in Washington continue to approve each country's separate lists. The Americans agreed but reserved the right to act unilaterally if excessive delay occurred again.[844] They had already devised a process by which they would coordinate monthly updates to

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[840] James Lay, Memorandum on the Subject "Disclosure of Technical Information to the U.S.S.R.," for the Commanding General, U.S. Military Mission to the U.S.S.R., 4 July 1944, Enclosure A to "Disclosure of Technical Information to the U.S.S.R," J.I.C. 138/18, 5 July 1944, Folder: 003185-001-0811; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0811&accountid=11752

[841] James Lay, "Note to the Secretaries," "Disclosure of Technical Information to the U.S.S.R," J.I.C. 138/17, 21 June 1944, Folder: 003185-001-0780; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0780&accountid=11752.

[842]"Memorandum by the Representatives of the British Chiefs of Staff," "Disclosure of Technical Information to the U.S.S.R.," C.C.S. 187/12, 11 July 1944, Folder: 003185-001-0815; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0815&accountid=11752.

[843] Joint Intelligence Committee, Report on "Disclosure of Technical Information to the U.S.S.R.," J.C.S. 527/9, 17 July 1944, Folder: 003185-001-0824; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0824&accountid=11752

[844] Memorandum by the United States Chiefs of Staff, "Disclosure of Technical Information to the U.S.S.R.," C.C.S. 187/13, 20 July 1944, Folder: 003185-001-0831; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0831&accountid=11752

their list of technology releasable to the Russians and did not want the British disrupting it again. They conveyed their position to the British representatives on 20 July 1944, the same day a group of German officers attempted to assassinate Hitler.

From the initial British proposal to coordinate technical disclosure, it had taken the British and Americans 17 months to negotiate a comprehensive policy on technology sharing with the Soviet Union and a process for updating the policy. Even then, they could not agree on a single policy but only on a respect for each other's similar policies. What theories best explain the policies of this period?

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1. Did the British and Americans support any sharing of military related technology with the Soviets? If yes, what technology sharing policy did they support?

Both the British and the Americans supported technology sharing with the Soviet Union during this period. The defining characteristic of a specified technology sharing policy as compared with a minimal technology sharing policy is the use of lists of technologies specifically cleared for release rather than the individual evaluation of specific requests. Beginning in March 1943 when the British proposed their lists of technologies for release to the Soviet Union, the preferred British policy shifted from minimal to specified. Despite later delays and variation in the technologies they supported disclosing, during this period, the British never retreated from their support for ongoing sharing of a specified list of technologies.

The Americans took longer to fully support ongoing sharing of technology with the Soviet Union. American officials continued to want to require reciprocity in technology exchange from the Russians for much longer than the British, even though some recognized this requirement was likely to result in little actual sharing. In a classic example of bureaucratic interest, some offices within the Navy Department were willing for the United States to freely share technology so long as any technology that office controlled still required individual release authorization. This resistance delayed the approval of combined technology sharing lists by about six months, but after renewed interest from the Combined Chiefs of Staff, driven by the British, a preliminary combined list appeared in the Fall. Importantly, by this point, it was no longer clear that the Americans were the sole source of friction. All the items on the "still awaiting approval" portion of the preliminary list required British review, though some also required U.S. Navy review.[845] Thus by October 1943, the preferred policy of the United States is best classified as specified, though the exact moment at which it transitioned from minimal over the summer is unclear. U.S. support for technology sharing only grew over the remainder of 1943 and 1944. From February 1944 on, the United States came to support technology sharing with the Soviets more than the British did even though both preferred specified technology sharing policies.

TOTT

1. What motivations, if any, did decisionmakers have to share technology? Did the sharing state face a severe and immediate threat that it shared with the potential recipient state?

The major motivation for sharing technology in this period continued to be the common war against Germany. While it is true that the German Army became less capable during this time as it suffered battlefield defeats, victory remained a distant goal. As discussed previously, the Western Allies continued to be worried the Soviets might make a separate peace with the Germans. Even after Anglo-American landings in France, the vast majority of the German Army

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[845] Combined Intelligence Committee, Interim Report to the Combined Chiefs of Staff on "Exchange of Technical Information with the U.S.S.R," C.C.S. 187/2, 1 October 1943, Folder: 003185-001-0644; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0644&accountid=11752

remained on the Eastern front. The Western armies would have struggled to defeat the Germans on their own. Bluntly put, they needed the Soviets to keep killing Germans if they were to achieve unconditional surrender.[846]

Throughout the process of developing a comprehensive technology sharing policy for the Soviet Union, decisionmakers made the point time and time again. We have already seen how for the British the standard became: would disclosing the technology allow the Russians to "kill more Germans."[847] The Americans thought similarly. In January 1944, the U.S. members of the Combined Subcommittee on Disclosure of Technical Information released guidance on interpreting the U.S. technical disclosure policy. They stated, "It is assumed that the fundamental motive in releasing technical information to the U.S.S.R. is the desire to render every possible assistance to Red Forces in the common war against Germany."[848] Lest there be any remaining doubt of the principle motivation for sharing technology with the Soviet Union, when the British tried to convince the Americans to join a tri-party information sharing agreement, they specifically spoke about how any provisions to share information with the Soviets would need to end when Germany was defeated.[849] The German threat motivated the United States and Britain to share technology with the Soviets.

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[846] The general estimate is that 9 of 10 German casualties in the Second World War occurred on the Eastern front.
[847] "Memorandum by Mr. Elbridge Durbrow of the Division of European Affairs*", 23 December 1943; Foreign Relations of the United States*, DIPLOMATIC PAPERS, 1943, THE BRITISH COMMONWEALTH, EASTERN EUROPE, THE FAR EAST, VOLUME III, eds. William M. Franklin and E.R. Perkins (Washington: Government Printing Office, 1963), Document 643; https://history.state.gov/historicaldocuments/frus1943v03/d648 [accessed 25 March 2021]
[848] U.S. Members, Combined Subcommittee on Disclosure of Technical Information to the U.S.S.R, Report on "Interpretation of U.S. Policy on Disclosure of Technical Information to the U.S.S.R.," 24 January 1944, Enclosure to James S. Lay, Note by the Secretary to "Interpretation of U.S. Policy on Disclosure of Technical Information to the U.S.S.R," J.I.C. 138/10, 25 January 1944, Folder: 003185-001-0717; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0717&accountid=11752.
[849] "Memorandum by the Representatives of the British Chiefs of Staff," "Disclosure of Technical Information to U.S.S.R." C.C.S. 187/5, 29 December 1943, Folder: 003185-001-0702; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0702&accountid=11752.

2. How did sharing state decisionmakers assess future interest alignment with the potential recipient state?

Both British and American decisionmakers continued to doubt whether their interests would continue to align with the Soviet Union after the war. The Americans did not expect with certainty that post-war relations with the Soviets would be hostile, but they certainly recognized that post-war interest alignment was no more likely than dis-alignment. For example, a September 1943 analysis from the Office of Strategic Services (OSS) commented that "indications" existed "that the Soviet Union [was] preparing for the eventuality of organizing its own security and interests independently, indications which show that under certain circumstances it might even do so at the risk of conflicting with Allied interests."[850] Indeed, although the report's author went to great length to suggest a cooperative post-war environment remained a possibility, he still had to admit the Soviets were "predisposed to play a lone hand."[851] Later in the period the OSS would evaluate Anglo-American cooperation with the Soviets as less than successful.[852] Senior U.S. uniformed leaders were well aware of these frictions. In May 1944, the Joint Chiefs of Staff discussed a planning paper that included an assessment of the United States' ability to defeat Russia in a war.[853]

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[850] Research and Analysis Branch, Office of Strategic Services, "The Bases [sic] of Soviet Foreign Policy," R&A No. 1109, 1 September 1943, Folder: 003321-003-0743; Office of Strategic Services (OSS)-State Department Intelligence and Research Reports, Part 06: Soviet Union, 1941-1949; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003321-003-0743&accountid=11752.
[851] Research and Analysis Branch, Office of Strategic Services, "The Bases [sic] of Soviet Foreign Policy," R&A No. 1109, 1 September 1943, Folder: 003321-003-0743; Office of Strategic Services (OSS)-State Department Intelligence and Research Reports, Part 06: Soviet Union, 1941-1949; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003321-003-0743&accountid=11752.
[852] Research and Analysis Branch, Office of Strategic Services, "Russian Aims in German and the Problem of Three-Power Cooperation," R & A No. 2073, 11 May 1944, Folder: 003321-002-0030; Office of Strategic Services (OSS)-State Department Intelligence and Research Reports, Part 06: Soviet Union, 1941-1949; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003321-002-0030&accountid=11752.
[853] Supplementary Minutes to the 162nd Meeting of the Joint Chiefs of Staff, 9 May 1944, Folder: 003181-002-0697; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-002-0697&accountid=11752.

If anything, the British were more concerned about future Russian threats than the United States. Winston Churchill famously favored focusing the Anglo-American offensive on the Mediterranean in part to limit the territory the Russians could occupy. He similarly told Roosevelt he wanted to ensure the French remained a military power after the war to counter-balance the Russians, a point Roosevelt conveyed to his Joint Chiefs.[854] Both the British and the Americans had concerns about future Russian intentions during this period

3. Did the decisionmakers express concerns about the ability of the recipient state to protect technological secrets?

While Anglo-American decision makers still thought security might be a criterion for technology sharing, by March 1943, the likelihood of Soviet defeat had diminished greatly, and it would continue to do so over the rest of the year as Russian battlefield victories mounted. This dramatically reduced Anglo-American concern that any technology they provided the Russians would leak to the Germans. In October 1943, the chance of German capture of radar equipment was only one of seven factors which were considered when deciding to release information.[855] This confidence steadily grew over the course of the summer of 1943. It was also demonstrated by the fact that analysis of whether to share technology with the Soviet Union was no longer grouped with China as it had been previously. The British and Americans had little confidence

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[854] Minutes of Meeting Between the President and the Joint Chiefs of Staff Held in the White House, 21 February 1944, Folder: 003181-002-0559; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-001-0342&accountid=11752

[855] Radar Committee, Report to the Combined Communication Board "Policy for Disclosure of Radar Equipment and Information to the U.S.S.R," C.C.B. 4/12, 2 October 43, Folder: 003185-001-0600; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0600&accountid=11752

that technology shared with China would not reach the Japanese and continued to pursue a more restrictive policy towards it.[856]

Moreover, by late 1943 the British and Americans were expressing confidence in Russian security measures. They had shared operational information with the Russians about the invasions of North Africa and Sicily without any effect on the operations and had also shared the essential details of the planning for the invasion of France. General Marshall noted on 26 October 1943 that "there was little to fear as to a Russian failure to maintain the security of the information committed to them."[857] By November 1943, when discussing technical disclosure policy, the Americans were willing to assume the Russians' secrecy was sufficient to prevent any technology provided them from reaching any other governments.[858] During the period, the British and Americans no longer worried about technology reaching the Germans via the Soviets.

In summary, the Germans remained a severe threat to Americans, British, and Soviets, more severe to the British and the Soviets than to the Americans. The British and the Americans continued to be uncertain about the future alignment of their intentions with the Soviets. The British and Americans were no longer concerned about technology they provided to the Soviets leaking to or being captured by the Germans. Under these circumstances, TOTT would predict the Americans and British would both pursue a specified technology sharing policy. TOTT

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[856] Minutes of the 186th Meeting of the Joint Staff Planners, 17 January 1945, Folder: 003181-006-0305; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-006-0305&accountid=11752

[857] Supplementary Minutes to the 120th Meeting of the Joint Chiefs of Staff, 26 October 1943, Folder: 003181-002-0100; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-002-0100&accountid=11752.

[858] "Report by the U.S. Representatives, Combined Subcommittee," "Disclosure of Technical Information to the U.S.S.R., 22 November 1943, Appendix to A. Sidney Buford, "Note by the Secretary" to "Disclosure of Technical Information to the U.S.S.R," J.I.C. 138/3. 25 November 1943, Folder: 003185-001-0683; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0683&accountid=11752

would also expect the British to come to prefer a specified technology sharing policy sooner in 1943 than the Americans because of the greater threat Germany posed to Britain. TOTT would expect the Americans might wait for more significant evidence of Soviet battlefield successes before increasing its willingness to share technical information. These predictions generally match what occurred.

Single-Period Structural Realism & Technological Capability

In this period, single-period structure realism would still support technology sharing. The Soviets, British, and Americans all continued to face a threat from Germany, but Allied battlefield successes meant the threat had lessened. Accordingly, we should expect continued but less liberal technology sharing than in the earlier period. Structural Realism does not provide for a nuanced predictions about technology sharing policy, but it might predict a specified technology sharing policy for Britain and a specified or minimal technology sharing policy for the United States.

Economic

In this period, economic reasoning played little role in contributing to technology sharing. Economic rationales did appear as a potential restraint of technology sharing, but when they did, they were overruled.

1. Did the sharing arrangement involve monetary payments to a sharing state?

No. The Soviets did not pay anything to either Britain or the United States for the technologies they received. Indeed, both Britain and the United States were providing substantial military and economic aid through lend-lease to the Soviet Union during this time.

2. Did leaders cite economic benefits as an important rationale or haggle over them?

No. At no point did decisionmakers appear to consider the economic benefits of sharing when making decisions about technical disclosure.

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

No, decisionmakers specifically considered potential economic barriers to technology sharing and overruled them. When the Combined Intelligence Committee prepared its report on the preliminary list of technology authorized for disclosure to the Soviet Union in October 1943, it noted that the patent rights of much of the equipment listed belonged to individuals or organizations other than the British or U.S. Governments. The Committee recommended that disclosure to the Soviets only occur in a fashion that would not hamper these entities' patent rights.[859] In approving the Committee's recommendations, however, the Combined Chiefs of Staff specifically altered them to remove the requirement that no information be disclosed to the Soviets "until all necessary steps have been taken to secure the proper owner all property rights in each individual item."[860] The Combined Chiefs of Staff wanted nothing to do with protecting patent rights for firms.[861] When the subject came up in the future, military and naval staff officers either assumed the problem away, or declared it would be dealt with after the war, or warned private firms to beware they would not receive assistance in protecting their intellectual property.[862] This approach characterized both British and American officers.

[859] Combined Intelligence Committee, Interim Report to the Combined Chiefs of Staff on "Exchange of Technical Information with the U.S.S.R," C.C.S. 187/2, 1 October 1943, Folder: 003185-001-0644; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0644&accountid=11752;

[860] Combined Intelligence Committee, Interim Report to the Combined Chiefs of Staff on "Exchange of Technical Information with the U.S.S.R," C.C.S. 187/2, 1 October 1943, Folder: 003185-001-0644; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0644&accountid=11752

[861] "Supplementary Minutes to the 121st Meeting of the Combined Chiefs of Staff, 1 October 1943, Folder: 003181-003-0158; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-003-0158&accountid=11752.

[862] Report by the U.S. Representatives, Combined Subcommittee," "Disclosure of Technical Information to the U.S.S.R., 22 November 1943, Appendix to A. Sidney Buford, "Note by the Secretary" to "Disclosure of Technical Information to the U.S.S.R," J.I.C. 138/3. 25 November 1943, Folder: 003185-001-0683; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault;

Civilian officials, as one might expect, displayed more concern for patent rights. In December 1943, Elbridge Durbrow of the State Department's Division of European Affairs repeatedly noted the Russians were known to purchase a few models of American equipment and copy them while refusing to sign licensing agreements. He recommended using proposals to exchange military information as leverage to force to Soviets to make a post-war licensing agreement, but the suggestion never received serious consideration with the Joint Chiefs of Staff.[863] In analyzing a British proposal for a tri-party information sharing agreement, he noted that Soviet purchasing officials in the United States asked for "very specific information" about equipment which seemed to have more post-war use than war time use.[864] He suggested some firms might be more willing to support the war effort if they knew they would have intellectual property protections, but his efforts went nowhere. Intellectual property protection never became a part of British or American military technology disclosure policy.

Organizational

1. What was the role of military organizations in shaping the sharing decision?

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https://congressional.proquest.com/histvault?q=003185-001-0683&accountid=11752.; Text of Draft Agreement as Drawn up by the Allied Supplies Executive," Enclosure B to" Memorandum by the Representatives of the British Chiefs of Staff," "Disclosure of Technical Information to U.S.S.R." C.C.S. 187/5, 29 December 1943, Folder: 003185-001-0702; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0702&accountid=11752; Draft Memorandum for the War and Navy Departments, Appendix to Joint Subcommittee on Technical Information, Report on "Visit of R.C.A. Representatives to the U.S.S.R.," J.I.C. 235/1, 16 November 1944, Folder: 003185-001-0848; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0848&accountid=11752.

[863] "Memorandum by Mr. Elbridge Durbrow of the Division of European Affairs*", 8 December 1943; Foreign Relations of the United States*, DIPLOMATIC PAPERS, 1943, THE BRITISH COMMONWEALTH, EASTERN EUROPE, THE FAR EAST, VOLUME III, eds. William M. Franklin and E.R. Perkins (Washington: Government Printing Office, 1963), Document 647; https://history.state.gov/historicaldocuments/frus1943v03/d647 [accessed 25 March 2021]

[864] Memorandum by Mr. Elbridge Durbrow of the Division of European Affairs*", 23 December 1943; Foreign Relations of the United States*, DIPLOMATIC PAPERS, 1943, THE BRITISH COMMONWEALTH, EASTERN EUROPE, THE FAR EAST, VOLUME III, eds. William M. Franklin and E.R. Perkins (Washington: Government Printing Office, 1963), Document 643; https://history.state.gov/historicaldocuments/frus1943v03/d648 [accessed 25 March 2021]

Military organizations continued to play the essential role in shaping technology sharing policy in this period. We have seen how OSRD continued to defer to the Joint Chiefs of Staff policy in determining sharing policy toward the Soviets.[865] Similarly, an official in the Office of Wartime Economic Affairs noted that policy on release of "industrial 'knowhow'" was "laid down by the Joint Chiefs of Staff and implemented by the armed services."[866] The Armed Forces remained in the driver's seat in determining technology sharing policy.

2. If military organizations were involved in the decision, were those armed forces operating in close quarters with the potential recipient state's armed forces?

   During this period, the U.S. Armed Forces, in particular, the U.S. Army Air Force came to operate in close quarters with the Soviet Union as part of the Operation FRANTIC shuttle bombing campaign. This was the only major combined combat operation coordinated between the Western allies and the Soviet Union during this time.

3. What was the role of scientific organizations in shaping the sharing decision?

As discussed, scientific organizations like OSRD deferred to military and naval organizations during this period. As one would expect, however, when scientists had the opportunity to advocate in support of technological collaboration, they usually did. For example, Vannevar Bush expressed his concurrence that "all possible aid within the bounds of necessary

[865] Appendix A to "Report by the U.S. Members, Combined Subcommittee on Disclosure of Technical Information," "Exchange of Medical Information with the U.S.S.R.," J.I.C. 138/13, 31 May 1944, Folder: 003185-001-0752; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0752&accountid=11752.

[866] Memorandum by Mr. Auguste Richard of the Office of Wartime Economic Affairs", 17 July 1944; Foreign Relations of the United States, DIPLOMATIC PAPERS, 1944, EUROPE, VOLUME IV eds. E. Ralph Perkins et al. (Washington: Government Printing Office, 1966), Document 993; https://history.state.gov/historicaldocuments/frus1944v04/d993 [accessed 25 March 2021]

security restrictions" should be given to Russia.[867] He expressed his hope that the Hastings Mission would lead to "free exchange" between the United States and the Soviet Union.[868]

Considering these factors, the organizational explanation would expect military SOPs to play a large role in shaping technology sharing policy. In general these SOPs favor secrecy, but when the armed forces of countries are operating in close proximity with each other they favor sharing. Thus, the organization theory would expect minimal sharing and bureaucratic obstacles to sharing for most of this period, but it would predict the Americans coming to favor sharing more technology with the Soviets after they approved Operation FRANTIC in February 1944.

These predictions generally match what occurred, but they do not coincide with events as well as TOTT's predictions do. Both the British and Americans did at various times put bureaucratic obstacles – such as delayed responses – in the path of a more generous technology sharing policy, and the Americans did later come to prefer that more generous policy.

The timing of the changes, however, coincide better with TOTT. The organizational explanation cannot explain why the British came to favor a specified technology sharing policy in March of 1943. The British had already spent six months ignoring the specifics of their agreement to share technology with the Soviets and go back to doing so later in 1944. Similarly, the Americans came to favor a specific technology policy four months before the Soviets approved Operation FRANTIC and a full nine months before the first shuttle bombing raid. Thus, TOTT tends to provide better predictions for desired technology sharing policy than do organizational explanations.

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[867] Vannevar Bush, Letter to Colonel Edwin Cox (Secretary, Joint Committee on New Weapons and Equipment), 26 August 1944, Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10; Entry 168; RG 227, NACP.

[868] Vannevar Bush, Letter to Colonel Edwin Cox (Secretary, Joint Committee on New Weapons and Equipment), 26 August 1944, Folder: BB-2000 Interchange of Technical Information with Russia 1940-1946; Box 10; Entry 168; RG 227, NACP.

<table>
<tr><td colspan="7">Table 6-2: Theory Predictions and Actual Values for Technology Sharing from Stalingrad to Germany</td></tr>
<tr><td></td><td>TOTT</td><td>Structural Realism</td><td>Economic</td><td>Organizational</td><td>Observed Desired</td><td>Observed Actual</td></tr>
<tr><td>Britain</td><td>Specified</td><td>Specified</td><td>None</td><td>Minimal</td><td>Specified</td><td rowspan="3">Minimal To Oct 43, then Specified</td></tr>
<tr><td>United States to Oct 1943</td><td>Specified</td><td>Specified/ Minimal</td><td>None</td><td>Minimal</td><td>Minimal</td></tr>
<tr><td>United States from Oct 1943</td><td>Specified</td><td>Specified/ Minimal</td><td>None</td><td>From Feb 1944: Share</td><td>Specified</td></tr>
</table>

Technology Sharing as the End of the War Approaches

It took 17 months from the British proposal to coordinate an Anglo-American technology sharing policy with the Soviet Union until the Americans finalized their disclosure list in July 1944. The system so laboriously created would last only a few months. The British and Americans had both always recognized that the goal of technology sharing with the Soviets was to support their war effort. Making use of newly disclosed technology took time. As the war's end came into sight the likelihood disclosing additional technology would affect the speed and cost of the remainder of the war lowered while the salience of a potential post-war competition with the Soviets rose. It did not take long.

The U.S. Joint Chiefs of Staff built a process to regularly update the list of technology authorized for disclosure to the Soviet Union. Once a month, the Combined Intelligence Committee would meet to review any updates. The first such update occurred on 25 August 1944.[869] This list contained several items which had previously been specifically prohibited, including detailed design and construction information of standard and armor-piercing incendiary bullets. It did not include any X-Band radars.

[869] "Disclosure of Technical Information to the U.S.S.R. Supplemental Lists (U.S.)," C.I.C, 25 August 1944, Folder: 003185-001-0836; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0836&accountid=11752.

Just under a month later, on 20 September, General Deane in Moscow cabled Washington: he recommended terminating any further technical disclosure to the Russians.[870] He thought the Soviets would not be able to put to "practical" use any newly disclosed information before the defeat of Germany.[871] He also noted that battlefield successes on both fronts seemed to be making the Russians more intransigent. They refused more and more British and American requests and continued to refuse to provide technical information of their own. Deane was unsure the Russians would significantly contribute to the war against Japan after the German defeat.

At that moment, it seemed the war might be over by Christmas. The combined Anglo-American armies had raced across France and reached the German border. On September 17th, Bernard Montgomery had launched Operation MARKET-GARDEN with the goal of rapidly seizing a bridgehead into Germany itself – though the operation was failing by the 20th. Deane was almost certainly aware of the situation as he received nightly reports from Eisenhower's headquarters on the day's events and future plans.[872] The Red Army had done similarly well. It had re-gained the Soviet Union's prewar borders and advanced into Poland.

Despite these successes, events had soured Anglo-American views of Russia's post-war intentions. With the Red Army on the outskirts of the city, on 1 August, the Polish Home Army had launched the Warsaw Uprising. Stalin halted his army. When the British and Americans sought permission to have planes slated to airdrop supplies to the resistance fighters land in the

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[870] John Deane (Head, U.S. Military Mission, Moscow), Cable M21041 to the War Department, 20 September 1944, Appendix B to Joint Intelligence Committee, Report on "Disclosure of Technical Information to U.S.S.R," J.C.S. 527/10 ,15 October 1944, Folder: 003185-001-0840; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0840&accountid=11752.

[871] John Deane (Head, U.S. Military Mission, Moscow), Cable M21041 to the War Department, 20 September 1944, Appendix B to Joint Intelligence Committee, Report on "Disclosure of Technical Information to U.S.S.R," J.C.S. 527/10 ,15 October 1944, Folder: 003185-001-0840; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0840&accountid=11752.

[872] Deane, *The Strange Alliance; the Story of Our Efforts at Wartime Cooperation with Russia*, 152.

Soviet Union. Stalin refused. Finally, in late September after the Poles were largely defeated, Stalin authorized an American resupply mission to land at the FRANTIC bases. The mission flew on 18 September, but due to wide dispersal of the drop the Soviets estimated the Germans recovered more than 95% of the supplies. The Soviets refused to authorize further resupply missions. The next day the American planes flew from Ukraine to bomb Hungary and landed in Southern Italy. Though the Soviets and Americans spoke about the possibility for future shuttle bombing missions in 1945, the flight would be the last of the FRANTIC missions. Deane sent his message one day later and stopped handing over any additional information.[873]

When the British learned of Deane's decision, they too paused their disclosures and requested more information from the U.S. members of the Combined Chiefs of Staff. The British wanted to stay in step with the Americans, but also pointed out that because of their technology sharing agreement with the Russians, it would be unlikely they could pause disclosures indefinitely.[874]

The U.S. Joint Intelligence Committee saw little reason to pause disclosures. It was not that they disagreed with Deane's reasoning. Rather, they pointed out that between U.S. deliveries under lend-lease, the shuttle bombing missions, British disclosures, and what information the Soviets had recovered from U.S. or British combat losses, there was little on the list the Soviets did not already know. The Committee sent Deane a list of information approved for disclosure but not yet disclosed but left it to him if he would provide the list of authorized disclosures to the Russians. In Washington, the policy would remain to disclose information cleared for release to

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[873] Of note, however, U.S. policy was that most technical disclosure would occur to Soviet officials in the United States.

[874] Memorandum by the Representatives of the British Chiefs of Staff, "Disclosure of Technical Information to the U.S.S.R," C.C.S. 187/15, 4 October 1944, Folder: 003185-001-0839; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0839&accountid=11752.

the Soviets if they asked about it.[875] Importantly, however, the Committee noted that it was actively applying Deane's point about ensuring that they only approved technical information for disclosure if the Soviets could make use of it before the end of the war when evaluating any further supplemental lists.[876]

Even though by November it was clear the war would not be over by Christmas, the Joint Chiefs of Staff still seemed to be shifting their focus to the post-war responsibilities for technology sharing. When the Radio Corporation of America requested to send a private mission to the Soviet Union that month, the Joint Subcommittee on Technical Information reiterated the standing Joint policy. While it required compliance with the policy, it pushed the actual decision back to the service departments, noting "security of technical information in the post-war period is a responsibility of the War and Navy Departments."[877] Such a statement indicates that by November 1944 the shadow of the post-war future, at least in the case of the Soviet Union, was clearly on the minds of those who made technology disclosure policy. The Subcommittee did reiterate both that no research and development information was authorized for disclosure to the Soviets and that the U.S. armed forces made no guarantees regarding Soviet respect for intellectual property.

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[875] Draft Message for the Head of the U.S. Military Mission to the U.S.S.R., Appendix C to Joint Intelligence Committee, Report on "Disclosure of Technical Information to U.S.S.R," J.C.S. 527/10 ,15 October 1944, Folder: 003185-001-0840; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0840&accountid=11752.

[876] NOTE: COVID-19 pandemic restrictions have closed further access to the U.S. National Archives at the time of writing (April 2021), but as I yet I have found no evidence that the supplemental lists of technology for release to the Soviets were ever updated after August 1944. Draft Message for the Head of the U.S. Military Mission to the U.S.S.R., Appendix C to Joint Intelligence Committee, Report on "Disclosure of Technical Information to U.S.S.R," J.C.S. 527/10 ,15 October 1944, Folder: 003185-001-0840; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0840&accountid=11752.

[877] Draft Memorandum for the War and Navy Departments, Appendix to Joint Subcommittee on Technical Information, Report on "Visit of R.C.A. Representatives to the U.S.S.R.," J.I.C. 235/1, 16 November 1944, Folder: 003185-001-0848; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0848&accountid=11752

At the level of the Joint Chiefs of Staff, technical disclosure policy to the Soviet Union received little additional attention. Technical disclosure policy more broadly, however, continued to develop. November 1944 marked the issuance of the first comprehensive technology disclosure policy that covered all U.S. allies. This policy, much of which was based on the earlier work done on policy for technical disclosure to the Soviets, divided countries into different groups and established different policies for each of them. The Soviet Union, however, remained in its own category and the basic rules for creating disclosure lists remained unchanged.[878] The policy was updated in January 1945. The updated version of the policy did reiterate the previously established criteria for considering technology for release to the Soviet Union. It also contained the reciprocity requirement, but it is unclear if this was a deliberate reintroduction or simply a repetition of the 1943 policy that had been effectively abandoned but never officially changed.[879] As was already done for the Soviet Union, the new policy did require specific lists to identify technology eligible for lesser allies – France, Netherlands, etc. – though those lists would not be approved until 7 May 1945, the day before Germany surrendered.[880]

Exactly when the United States and Britain ceased disclosing new technology to the Soviet Union is unclear without further research – so much so that only an attempt to determine American policy. For the Americans two dates seem possible. The first, as already discussed, is

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[878] A.J. McFarland and E.D. Graves Jr, "Note by the Secretaries" to Joint Chiefs of Staff, "Memorandum of Policy No. 5: Basic Policy Governing the Disclosure of Technical Information to Foreign Governments," Issued 28 November 1944, First Revision 26 February 1945; Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP. – supplements the existing policy in JCS 572/2 on USSR approved 23 Dec 1943 by Joint Deputy Chiefs of Staff for JCS, also references CCS policy on radar and China, Revision was addition of enclosure

[879] A.J. McFarland and E.D. Graves Jr, "Note by the Secretaries" to Joint Chiefs of Staff, "Memorandum of Policy No. 5: Basic Policy Governing the Disclosure of Technical Information to Foreign Governments," Issued 28 November 1944, First Revision 26 February 1945; Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP. – supplements the existing policy in JCS 572/2 on USSR approved 23 Dec 1943 by Joint Deputy Chiefs of Staff for JCS, also references CCS policy on radar and China, Revision was addition of enclosure C

[880] F.J. Horne (VCNO), Letter on the Subject "Disclosure of Technical information to Foreign Governments – Procedure to Govern," from Chief of Naval Operations to the Chiefs of the Bureaus of Ships, Ordnance, and Aeronautics, Serial No. 00884716, 7 May 1945, Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP.

September 1944, which would indicate real consequences to the deteriorating relations between the United States and Soviet Union while much fighting remained. The other is April 1945.

Just four days after FDR's death on 12 April 1945, General Deane sent a message from Moscow to the Joint Chiefs in which he recommended significant changes to U.S. policy towards the Soviet Union. Deane argued that the Soviets perceived American generosity as weakness and that the United States officials should remain friendly with their Russian counterparts but to withdraw from cooperative projects unless essential to the war and wait for the Soviets to make the first move on collaboration.[881] The Joint Chiefs of Staff approved most of Deane's recommendations the next day, and the remainder a week later.[882] Though none of these decisions specifically mention technical disclosure – possibly because it had already effectively ceased – any ongoing disclosures of new information would almost certainly have ended as a result of the policy.

Soviet interest in scientific coordination, which had never been high, quickly waned as the United States reduced Lend-Lease after the defeat of Germany. The U.S. Navy continued to be interested in gaining access to Soviet scientific information. Just after VE-Day, the Navy's research director requested the State Department provide information whenever Soviet scientists visited the United States so the Navy could attempt to arrange interviews. In large part this request occurred because of the inability of the U.S. Naval attaché in Moscow to be able to gain

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[881] Memorandum by the Commanding General, U.S. Military Mission, U.S.S.R., "Revision of policy with Relation to Russia," J.C.S. 1313, 16 April 1945, Folder: 003185-001-0177; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; Proquest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0177&accountid=11752.

[882] For next day approval, see A.J. McFarland and E.D. Graves, "Note by the Secretaries," "Decision on J.C.S. 1313," 17 April 1945, Folder: 003185-001-0177; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0177&accountid=11752.. For remainder, see Senior Members of the Joint Staff Planners, Report on "Revision of Policy with Relation to Russia," J.C.S. 1313/2, 23 April 1945, Folder: 003185-001-0222; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0222&accountid=11752.

information.[883] The U.S. Director of Naval Intelligence requested the ability to confer with Soviet scientists visiting the United States from the senior naval member of the Soviet Government Purchasing Commission in Washington.[884] He was, however, quickly told that until the Lend Lease issue was sorted out nothing could be done.[885]

Indeed, the approaching end of the war was already beginning to effect U.S. technology sharing policy with Britain. On 20 April, the head of the U.S. Navy recommended isolating research projects that were not expected to bear fruit before the end of the war from projects in which the British were involved.[886] This was not new policy per se, but rather implementation of the now relevant pre-existing policy only to share research on projects that would be useful during the war. This recommendation was broadly implemented, though differences of opinion about when the war might end led to a Joint Intelligence Committee decision a month later to assume 1 January 1947 as the projected end date for the war in the Pacific.[887] Even with such a distant date, several projects were affected. It is unimaginable that if such restrictions were being placed on technology sharing with the British, technology sharing with the Soviets was unaffected.

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[883] J.W. Gregory (Captain, USN, Assistant Director, Intelligence Group), Memorandum on the subject "Russian Scientists who Visit the U.S.A," for Chief, Division of Foreign Activity Correlation, Liaison War-Navy Department, Department of State; 11 May 1945, Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP.

[884] Hewlett Thebaud (U.S. Director of Naval Intelligence), Letter to Rear Admiral A.A. Yakimov (Deputy Chairman of the Board, Soviet Government Purchasing Commission, Washington, D.C.), Serial 0735316, 11 May 1945, Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP.

[885] A.A. Yakimov (Rear Admiral U.S.S.R. Navy, Vice Chairman), Letter to Rear Admiral Hewlett Thebaud (Director of Naval Intelligence), 22 May 1945, Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP.

[886] R.S. Edwards (Deputy), Letter on the Subject "Material Developments Programs and Priorities" to the Coordinator of Research and Development from Commander in Chief, United States Fleet and Chief of Naval Operations, Serial 00982, 20 April 1945, Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP.

[887] Memorandum on the Subject "Disclosure of Technical Information to Foreign Governments," for Assistant Chief of Staff, OPD, WDGS and Commander-in-Chief, United States Fleet, [No Date], Attached to Joint Intelligence Staff, "Disclosure of Technical Information to Foreign Governments," JIC 265/3, 19 May 1945, Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP.

DV

1. Did American decisionmakers support any sharing of military related technology? If yes, what technology sharing policy did they support?

Yes. American decisionmakers continued to support a specified technology sharing policy during this period in that they continued to maintain a list of technologies authorized for disclosure to the Soviet Union. A specified technology sharing policy is characterized by ongoing provision of technological information so long as the technology is part of a pre-approved allowlist. A minimal technology sharing policy requires for individual approval of each transfer of information or each mission to transfer information and often involves a quid pro quo. The American technology sharing policy in this period clearly fits the definition of a specified technology sharing policy, but the liberalness of the policy was decreasing. In either September 1944 or April 1945, the United States ceased updating its allow list with new technologies. Technology transfers of any sort likely ceased immediately after VJ-Day with the end of Lend-Lease for the Soviet Union. The end of Lend-Lease for the Soviets was so abrupt that port officials loading Soviet ships on the U.S. west coast stopped moving cargo unless the Soviets paid for it. Further research is required to determine how British technology sharing changed in this period.

TOTT

1. What motivations, if any, did decisionmakers have to share technology?

During this period the British, Americans, and Soviets continued to face a common enemy in Germany, but the severity of this threat was waning. By late 1944, it was growing increasingly unlikely that the Germans would be able to defeat the Allies, even if they could still inflict significant damage. The war continued to provide the motivation for the technology sharing that did occur, but as shown earlier the fact that the end of the war was coming into sight was forefront on decisionmakers' minds.[888] For example in the Spring of 1945, instructions to the U.S. Navy about Joint Chiefs of Staff policy continued to stress the difference between information which was versus was not "directly applicable to the prosecution of the war."[889]

2. How did sharing state decisionmakers assess future interest alignment with the potential recipient state?

During this period British and American decisionmakers continued to be skeptical their future interests would align with Soviet interests, and evidence of potential interest misalignments grew. General Deane highlighted the divergence of post-war interests in analysis he provided in preparation for the Yalta Conference. He noted the Soviets understood that their vision of the peace had the potential to be "quite different" from the Western Allies' vision.[890] Deane thought this perspective led to Soviet skepticism of American and British intentions. Such analysis undoubtedly influenced American assessments of Soviet intentions. By April and May assessments of potential interest misalignment were hardening. When recommending reducing cooperation with the Soviets in April 1945 he wrote that Russia had become "so sure of her strength as to assume an attitude of dominance with respect to her Allies."[891] In May 1944, the OSS assessed that Russia had gone far further than the British or Americans in hedging against a

[888] Of note, total alliance strength seems to have mattered more to individual states evaluations than their own strength. By August of 1944, the British Army was so short on replacements that it had to disband active units to fill holes in other units. Stephen Ashley Hart, *Colossal Cracks: Montgomery's 21st Army Group in Northwest Europe, 1944-45* (Stackpole Books, 2007).

[889] R.A. Krause, Memorandum on the Subject "Interviews with Russian Scientists" to Admiral Furer, No Date [Spring 1945], Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP.

[890] -Memorandum by the Commanding General, U.S. Military Mission, USSR for the United States Chiefs of Staff, "Present Relations Between the United States Military Mission, Moscow and the Soviet Military Authorities," 22 January 1945, Folder: 003185-002-0183; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-002-0183&accountid=11752

[891] Memorandum by the Commanding General, U.S. Military Mission, U.S.S.R., "Revision of policy with Relation to Russia," J.C.S. 1313, 16 April 1945, Folder: 003185-001-0177; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0177&accountid=11752.

failure of three power cooperation.[892] The goal is not to make an argument about responsibility for the origin of the Cold War, but to better understand the attitude of American decisionmakers about the potential for future hostility with the Russians as the end of the war approached. From that perspective, by late 1944 American concern was growing. Once the war ended, these latent hostilities burst forth. By August 1945, even before the formal Japanese surrender, the Joint Staff Planners were already making plans for total war with the Soviet Union.[893]

3. Did the decisionmakers express concerns about the ability of the recipient state to protect technological secrets?

No. By this late point in the war concerns about Russian security had disappeared from the discussions about technical disclosure. This change was likely due to a combination of three factors. The first, already discussed, was growing concerns about Russia itself. Second, the British and Americans had more experience with Soviet security mechanisms by this point in the war. They had both seen the Soviets' frustrating and dangerous thoroughness in the coordination of the shuttle bombing missions, and they had seen that previously provided technology had not leaked. Finally, as the end of the war approached, the likelihood that the Germans would have the time to exploit any disclosures of Allied technology decreased significantly. As a result, even if technology did leak to the Germans the chance, they could use it to harm the allied war effort was reduced. Similarly, while American officials had previously worried about technology

[892] Research and Analysis Branch, Office of Strategic Services, "Russian Aims in German and the Problem of Three-Power Cooperation," R & A No. 2073, 11 May 1944, Folder: 003321-002-0030; Office of Strategic Services (OSS)-State Department Intelligence and Research Reports, Part 06: Soviet Union, 1941-1949; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003321-002-0030&accountid=11752

[893] Minutes of the 216th Meeting of the Joint Staff Planners, 29 August 1945, Folder: 003181-006-0694; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, Meetings of the Joint Chiefs of Staff, Combined Chiefs of Staff, Joint Staff Planners, and Joint Logistics Committee; ProQuest History Vault; https://congressional.proquest.com/histvault?q= 003181-006-0694&accountid=11752

leaking to the Japanese via the Soviets, by this late state in the war, these concerns no longer appeared to have existed.

Overall, in this period a mutual threat still existed, though it was lessening, and the British and Americans continued to have concerns about Russia's future intentions, concerns that were growing. Give this combination of factors TOTT would predict that the Western Allies would continue to maintain a specified technology sharing policy toward Russia. Given the shift in the strengths of the present and future threat variables, TOTT might expect that specified technology sharing to become less generous that it had previously been. This pattern matches what occurred.

Single-Period Structural Realism & Technological Capability

By the time the Allied armies had reached the borders of Germany, the Germans had essentially ceased to pose a significant threat to Britain, the United States, or the Soviet Union. While Germans could still kill many Allied troops, it would have been almost impossible for them to launch an offensive capable of reaching the territory of one of the major allied powers. The best the Germans could hope for was to split the alliances and negotiate peace. Under these conditions, this theory, which looks only at the threat posed to the states involved in technology sharing and the technical capability of the recipient states, would predict that technology sharing would cease altogether. This predication is akin to alliances falling out on the eve of victory.[894] Thus for Britain and the United States, it would predict a technology sharing policy of none.

Economic

Even as the war approached its end, economic considerations do not appear to have been an important factor in technology sharing policy towards the Soviet Union. The new Joint Chiefs of Staff policy on general technology sharing created in November 1944 did include a provision

[894] Waltz, *Theory of International Politics*.

for the release of technical information for "political or economic purposes to forward the war effort."[895] Only unclassified information or information classified "Restricted," – the lowest level – was authorized for release under this policy. Information at these classification levels was already authorized for release to the Soviet Union, so this change in policy did not affect technology sharing with Russia. Moreover, the low level of information authorized for sharing for economic reasons itself suggests the unimportance of economic rationales in driving sharing.

1. Did the sharing arrangement involve monetary payments to a sharing state?

   No. The Soviet Union continued to receive Lend-Lease aid during this period.

2. Did leaders cite economic benefits as an important rationale or haggle over them?

   No. Economic side payments did not receive significant discussion in this period.

3. When other motivations for sharing existed, did leaders refrain from sharing because of concern over future economic competition?

   No. As long as the war continued, concerns of economic competition did not seem to affect the technology sharing decision.

Organizational

1. What was the role of military organizations in shaping the sharing decision?

Military organizations continued to have the primary role in shaping technology sharing decisions in this period.

2. If military organizations were involved in the decision, were those armed forces operating in close quarters with the potential recipient state's armed forces?

In general, no. The FRANTIC bombing missions never resumed after September. While the American airbase remained at Poltava in Ukraine to assist with planes that made emergency

[895] "Basic Principles Governing the Disclosure of Technical Information to Foreign Governments," Appendix to "Disclosure of Technical Information to Foreign Governments, Report by the Joint Intelligence Committee." J.C.S. 927/2, 18 November 1944; Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP.

landings in Soviet controlled territory, relations at the base deteriorated. Strategic coordination between the Allies remained minimal. The British and Americans would roughly coordinate the timing of their offensives with the Soviets to ensure the Germans could not move forces between the fronts, but little more occurred.[896] Procedures for link-up in Germany were based mostly on geographic lines of demarcation and occasionally on pre-agreed identification signals.[897] Tactical coordination was virtually non-existent. On more than one occasion the American planes accidently attacked Soviet forces or vice versa.[898] No locally coordinated assaults occurred in Germany. In short, even as the Anglo-American and Soviet armies approached each other, they did not engage in combined operations.

3. What was the role of scientific organizations in shaping the sharing decision?

Scientific organizations continued to defer to military organizations during this period. OSRD did not initiate any new sharing initiatives with the Soviets.

Given this set of circumstances, the organizational explanation for technology sharing would expect a more scaled back technology sharing policy on the part of the United States and

Table 6-3: Theory Predictions and Actual Values for Technology Sharing as the End of the War Approaches

	TOTT	Structural Realism	Economic	Organizational	Observed Desired	Observed Actual
Britain	Specified	None	None	Minimal	TBD	TBD
United States	Specified	None	None	Minimal	Specified	Specified

Britain. Military organizations generally follow their SOPs of secrecy unless sharing technology would increase interoperability. Even as British and American forces approached Soviet forces, the two sides chose not to undertake combined operations. Moreover, with the end of the war

[896] Deane, *The Strange Alliance; the Story of Our Efforts at Wartime Cooperation with Russia*, 141–61.
[897] Dwight D. Eisenhower, *Crusade in Europe* (Garden City, NY: Doubleday & Company, 1948), 411.
[898] Deane, *The Strange Alliance; the Story of Our Efforts at Wartime Cooperation with Russia*, 126–40.

approaching, the likelihood that the Soviets could put the technology into use in time for it to affect interoperability was small. As such, an organizational explanation would predict a return to a minimal technology sharing policy.

International or Organizational Constraints: The British Comparison

A desire to hold the alliance together meant that few decisionmakers were likely to directly express their concerns about future Russian intentions as a reason to hold back technology, but the record nonetheless contains several hints that this concern affected their decisions. For example, in creating its supplementary guidance for determining technical information authorized for disclosure to the Soviet Union, the U.S. members of the Combined Subcommittee on Disclosure of Technical Information to the U.S.S.R. identified "three principal strategic considerations which might influence the release of information." The first of these considerations was: "Is the information of such vital importance to the national security of this Country [the United States] that it cannot be safely allowed in the hands of any foreign nation?"[899] While on its face, this argument seems to be independent of concerns about any specific state, its inclusion in a document specifically about the Soviet Union at a time when the United States had a much closer technological relationship with its other major ally – Britain – suggests otherwise. Indeed, some of the strongest evidence state-specific international factors rather than organizational concerns restrained the Western Allies' technological generosity to the Soviets is the difference between the way Britain and the United States treated each other and the

[899] The other considerations where whether the technology might be compromised for us in other by early release to the Soviets and whether the technology could be used to gain strategic surprise. U.S. Members, Combined Subcommittee on Disclosure of Technical Information to the U.S.S.R, Report on "Interpretation of U.S. Policy on Disclosure of Technical Information to the U.S.S.R.," 24 January 1944, Enclosure to James S. Lay, Note by the Secretary to "Interpretation of U.S. Policy on Disclosure of Technical Information to the U.S.S.R," J.I.C. 138/10, 25 January 1944, Folder: 003185-001-0717; Records of the Joint Chiefs of Staff, Part 1: 1942-1945, The Soviet Union; ProQuest History Vault; https://congressional.proquest.com/histvault?q=003185-001-0717&accountid=11752.

way they treated the Russians. Concerns unique to Russia – first that it might fall to the Germans and later about a future Russian threat – motivated British and American restrictions despite the war with Germany. Had these restraints been driven by purely organizational concerns, we would not expect variation across how different great power allies were treated even before the British and Americans were fighting together.

From shortly after the Tizard Mission – discussed in the previous chapter – until the summer of 1945, the United States and Britain fully coordinated their technological research and development programs. They shared their most cutting-edge production technology too. The scope and scale of this coordination was astounding. By 1 January 1945, the United States had provided the British 16,380 research reports in 24 categories. In that same time, the United States received from the British and the British Commonwealth 35,500 research reports.[900] Many of these reports were classified. There were no lists of technologies authorized for sharing. With very few exceptions, if the Americans or British developed or produced it, the other had access to it. It is hard to exaggerate how closely integrated the two countries' research programs were throughout the war.

By contrast, the only research and development exchange which took place between the Soviet Union and the United States covered medical subjects (one of the 24 categories of exchange). The Combined Chiefs of Staff had prohibited the release of any other research and development information to the Russians. Of the 16,380 reports the United States provided to Britain, 4000 covered medical research. The Soviets only received a total of 750 research reports from the United States, all covering medical research. The United States received from the

[900] Eugene W. Scott (Assistant Liaison Officer, OSRD), Letter to Homer Jones (Director, Clearing Office for Foreign Transactions and Reports, Foreign Economic Administration), 15 March 1945, Folder AA-1220 Distribution of OSRD Reports 1940-1946; Box 1; Entry 168; RG 227; NACP.

British about 3000 medical research reports. From the Soviet Union, the United States received a total of 154 reports, all on medical subjects and mostly unclassified.[901] The official report on the activities of the Office of Scientific Research and Development in Europe made no mention of the Soviet Union in its 50 page summary or its administrative history.[902] The stark difference between the treatment of Britain and the Soviet Union – or in the case of the British, between the United States and the Soviet Union – provide strong evidence that organizational factors do not explain the major differences in their treatment, since the same organizations were making decisions about sharing. Indeed, as we have seen, so close was the integration of Britain and the United States that they attempted, with varying degrees of success, to coordinate their technology sharing policy towards Russia.

The comprehensive sharing of technological information and research between the British and the Americans only began to slacken after the defeat of Germany, but even then, it did not end right away. Since American technology sharing policy toward Britain was justified based on the war – technology could only be shared if it was thought the recipient could make use of it before the war was over[903] –, the pending defeat of Germany affected American policy. As already mentioned, in April 1945, the Navy began segmenting research projects which were not expected to bear fruit before 1947. At this same time, the OSRD office in London, seeing the end of the war with Germany coming, began the process of wrapping up its activities in Europe –

[901] Eugene W. Scott (Assistant Liaison Officer, OSRD), Letter to Homer Jones (Director, Clearing Office for Foreign Transactions and Reports, Foreign Economic Administration), 15 March 1945, Folder AA-1220 Distribution of OSRD Reports 1940-1946; Box 1; Entry 168; RG 227; NACP.
[902]The other sections of the report deal with specific technology areas. Bennett Archambault (Head of OSRD London Mission), "Part one of Report of OSRD Activities in the European Theater During the Period March 1941 through July 1945," 15 April 1946, Folder: Part I; Box 128A; Entry 176; RG 227, NACP; Bennett Archambault, "Part Two: Administrative Report of OSRD Activities in the European Theater During the Period March 1941 through July 1945, 1946; Folder: Part II, Box 128A: London Mission Reports, Part One, Part Two, and Part Three (Box 128A), Entry 176, RG 227, NACP.
[903] Joint Intelligence Staff, "Disclosure of Technical Information to Foreign Governments," JIC 265/3, 19 May 1945, Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP

though this process would take until 1946 to complete.[904] The beginning of the wind-down of technological cooperation with the British marks an intriguing potential similarity with the Soviet Union, since one of the two potential dates for the end of new technological disclosures to the Soviet Union is mid-April 1945. This evidence suggests the overriding importance of the German (and to a lesser extent Japanese) threat in motivating technology sharing with any other major power. Indeed, American restrictions on sharing with the British would soon grow.

While the German surrender on 8 May 1945 led to communications which directed technology sharing with the British should not cease.[905] Confusion soon developed. The Joint Intelligence Committee had to announce that 1 January 1947 should be used as the assumed end date of the war with Japan, which formalized the policy the Navy had already undertaken to restrict longer term research from the British.[906] American research resources already vastly outstripped the British. Unlike the fighting against the Germans, the Americans expected to shoulder the bulk of the fighting in the invasion of the Japanese home islands – and even tried to keep ground British participation to a minimum.[907] As a result, the military benefits of continued research collaboration with the British were minimal.

The American restrictions quickly increased. The Americans initially ceased sharing radar information, which had been the core of Anglo-American collaboration, on 1 July 1945,

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[904] Bennett Archambault, "Part Two: Administrative Report of OSRD Activities in the European Theater During the Period March 1941 through July 1945, 1946, p. 40; Folder: Part II, Box 128A, Entry 176, RG 227, NACP.
[905] Joint Intelligence Staff, "Disclosure of Technical Information to Foreign Governments," J.I.C. 175/20, 10 May 1945, Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP.
[906] Memorandum on the Subject "Disclosure of Technical Information to Foreign Governments," for Assistant Chief of Staff, OPD, WDGS and Commander-in-Chief, United States Fleet, [No Date], Attached to Joint Intelligence Staff, "Disclosure of Technical Information to Foreign Governments," JIC 265/3, 19 May 1945, Folder: Exchange of Information II, Box 75, Entry UD1, RG 298, NACP.
[907] D. M. Giangreco, *Hell to Pay: Operation DOWNFALL and the Invasion of Japan, 1945-1947* (Annapolis, MD: Naval Institute Press, 2017), 30–35, http://ebookcentral.proquest.com/lib/jhu/detail.action?docID=5333069.

though this decision prompted a protest by the British Government.[908] The reduction in technical cooperation coincided with a significant reduction in Lend Lease aid to Britain as well.[909] The sudden Japanese surrender after the dropping of the atomic bombs and the Soviet declaration of war only sped up this process. By 1946 the restrictions had increased – particularly involving atomic weapons – and the British would later complain that 1946 was when the United States began to cut off British scientists from American research. The British, on the other hand, knew that the Americans now had far more scientific research capability and continued to supply their research to the Americans to preclude the Americans citing British intransigence as an excuse for the reduced sharing.[910] Though Anglo-British technical cooperation was much closer than Soviet cooperation, American sharing with both states fell off quickly with German and then Japanese defeat.

Conclusion

Table 6-4 displays the values for technology sharing policy that TOTT and the alternative explanations predict alongside the actual observed values for both British and American technology sharing with the Soviet Union and with each other during most of the Second World War. A quick overview of the table reveals that only two theories, TOTT and Organizational explanations come close to providing a satisfactory explanation for the observed desired technology sharing policies of both Britain and the United States. TOTT predicts a more

908 I have not yet been able to determine, if this protest was effective in temporarily restoring radar collaboration, but even if it was, the fact that the Americans had been willing to unilaterally end collaboration without prior announcement indicates how rapidly the situation had changed. Chiefs of Staff Committee, "Note on D.C.C.S(45)58 (Final): Collaboration with the United States on Research and Development," 10 July 1945, TNA: WO 193/306.
909 Giangreco, *Hell to Pay*, 32.
910 Chiefs of Staff Committee, "Confidential Annex to C.O.S. (48) 176th Meeting held on Thursday, 9th December 1948," 10 December 1948, TNA: DEFE 4/18. 7

generous technology sharing policy early in the war than observed, while organizational explanations underpredict generosity for Britain and towards the war's end.

Deeper examination, however, suggests that the evidence tends to support TOTT more. Unlike in later years, early in the war multiple factors that TOTT expects to restrain the generosity of technology sharing occurred simultaneously – namely uncertainty both about the Soviets' future intentions and concern about their ability to keep the Germans from seizing any technology the British and Americans provided. Both these factors existing simultaneously likely suppressed British and American willingness to share technology with the Soviets more than TOTT would expect. Similarly, while organizational explanations do predict an increasing American willingness to share technology with the Soviets in 1944 after the Soviets accepted the American proposition to shuttle bomb Germany, the generosity of U.S. technology sharing policy was already increasing prior to this agreement. The timing of the change is more in line with TOTT's predictions than with those of organizational explanations.

The case of Anglo-American technology sharing with the Soviet Union provides evidence for the influence of the international threat environment on technology sharing policy. The German threat drove the Western allies to share technology with the Soviets, while concerns about the Soviets ability to protect that information and their future intentions reduced their generosity. In general, differences in the severity of the threat faced by Britain and the United States and differences in their expectations of post-war interest alignment with the Soviets tend to correlate with differences in their sharing policies towards Russia. The clear difference between technology sharing between the United States and Britain and between those two countries and the Soviet Union starkly shows the influence of uncertainty about future intentions on technology sharing policy.

Most surprising, perhaps, is just how generous the British and Americans were with the Soviets despite their concerns. As much as the technologies offered to the Soviets were constrained, on multiple occasions officials were told to err on the side of providing as much information within the bounds of the policy as possible. While the British and Americans never provided information on weapons in the research and development stage and refused to release their newest radars until still newer versions were nearing production, they did offer technologies that were only a few years old and still in widespread use with their own operating forces. Indeed, the provision of IFF Mark III to the Soviets would become a major concern in the Korean War, where UN forces still used it in the first years of the conflict, despite the development of two newer versions of IFF during the Second World War. While the newest versions of the technologies the British and Americans withheld often provided new capabilities, rarely would the technology have provided a major advantage over an opponent equipped with the previous version. By 1944, the technologies withheld from the Russians seemed more to be about "staying a technology ahead" than the actual difference in capability.

<table>
<caption>Table 6-4: Theory Predictions and Actual Values for Technology Sharing</caption>
<tr><th></th><th>TOTT</th><th>Structural Realism</th><th>Economic</th><th>Organizational</th><th>Observed Desired</th><th>Observed Actual</th></tr>
<tr><td>To Stalingrad - Britain</td><td>Specified</td><td>Open</td><td>None</td><td>Minimal</td><td>Minimal</td><td rowspan="5">To Oct 43: Minimal

Oct 43 to Sep 44: Specified</td></tr>
<tr><td>To Stalingrad - U.S.</td><td>Specified</td><td>Specified</td><td>None</td><td>Minimal</td><td>Minimal</td></tr>
<tr><td>Stalingrad to Germany - Britain</td><td>Specified</td><td>Specified</td><td>None</td><td>Minimal</td><td>Specified</td></tr>
<tr><td>Stalingrad to Germany – U.S. to Oct 1943</td><td>Specified</td><td>Specified/ Minimal</td><td>None</td><td>Minimal</td><td>Minimal</td></tr>
<tr><td>Stalingrad to Germany – U.S. after Oct 1943</td><td>Specified</td><td>Specified/ Minimal</td><td>None</td><td>From Feb 1944: Share</td><td>Specified</td></tr>
<tr><td>End Approaches - Britain</td><td>Specified</td><td>None</td><td>None</td><td>Minimal</td><td>TBD</td><td rowspan="2">Specified – no additional technologies released</td></tr>
<tr><td>End Approaches – U.S.</td><td>Specified</td><td>None</td><td>None</td><td>Minimal</td><td>Specified</td></tr>
<tr><td>U.S. sharing with Britain 1941-1945</td><td>Open</td><td>Open at start, and decreasing during war</td><td>None</td><td>Share</td><td>Open</td><td>Open</td></tr>
<tr><td>U.S. sharing with Britain 1941-1945</td><td>Open</td><td>Open at start, and decreasing during war</td><td>None</td><td>Share</td><td>Open</td><td>Open</td></tr>
</table>

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Chapter 7
Conclusion

The purpose of this dissertation is to contribute to our understanding of how states understand and manage technology as a component of their national power. To that end, it has sought to answer the question of when and why states share advanced military technology with other states. To do so I have undertaken three steps. First, I defined technology sharing and established what makes it different from other forms of security assistance. Second, I developed a theory to explain the circumstances under which states that are innovating along the technological frontier share their advanced military technology with states of similar technological capabilities. Third, I tested that theory against a series of cases from the first half of the twentieth century. The contributions and conclusions of each of these steps follow.

Major Arguments

The dissertation's first contribution is to establish technology sharing as a distinct form of security assistance. When states seek to work with allies and partners to improve their mutual security, they have several options including alliances, arms sales, training and exercises, intelligence sharing and technology sharing. As used in this dissertation, technology sharing means providing a partner state the information, equipment, or expertise to help the receiving state develop the capability to produce advanced military, naval, or air material without continued outside assistance. Technology sharing differs from other forms of security assistance in two distinct ways. First, technology sharing is the only form of security assistance besides intelligence sharing that involves a high risk to the sharing state's own capability. If an adversary were to gain access to shared technical information, it becomes much more likely they will either be able to develop countermeasures to the technology or be able to adopt it themselves. Either situation negatively affects the sharing state's capability. Second, technology sharing is the only form of security assistance with highly persistent benefits in that the sharing state cannot claw back the security benefits it has provided the recipient if relations between the two states worsen. The unique combination of these two attributes shapes the theoretical explanation for when states choose to share technology.

This dissertation's second contribution is to develop a theory to explain when states choose to share technology with other states and how liberal their technology sharing policy is. Called Threats over Time Theory (TOTT), this theory explains decisions to share technology using four variables: current threats to the state, current existential threats to sub-state organizations that control technology, the likelihood a future adversary will gain technology because of sharing, and the pace of innovation. Many mutually re-enforcing barriers make technology sharing rare, but both significant threats to the state and existential threats to sub-state organizations that control technology are powerful enough motivations to overcome these barriers. Even in those cases, however, the likelihood that sharing technology with a given recipient will lead a future adversary to gain access to that technology will affect the liberality with which technology is shared. Two factors affect the likelihood that sharing a technology will lead to a future adversary gaining a technology: the chance the technology will leak from the recipient to an adversary and the likelihood the recipient will itself become the sharer's adversary. The risk a future adversary will gain a technology remains an important factor in technology sharing decisions even when powerful current threats motivate technology sharing because of the persistence of the benefits of technology sharing. Thus, the final factor which can affect a state's generosity is the pace of innovation. When decisionmakers perceive the pace of innovation as fast, the shadow of the future benefits any technology they may provide to a recipient is shorter, and thus the risk of the sharing leading to a future adversary gaining the technology matters less.

Finally, this dissertation tests TOTT against four cases from the first part of the twentieth century: British technology sharing with the United States during and after the First World War; British naval aviation technology sharing with Japan after the First World War; British technology sharing with the United States in the years just prior to and during the Second World War; and Anglo-American technology sharing with the Soviet Union during the Second World War. I select cases from the period between the First and Second World Wars (inclusive) because during this era multiple great powers worked to develop technologies that would reshape warfare while their alignments changed through periods of both war and peace. These characteristics provide variation across all variables of interest. Additionally, the period is sufficiently in the past to provide rich data sources while not being so distant as to be unrelatable to our own time.

Review of the Evidence

TOTT generates predictions for specific technology sharing under specific circumstances. When a state faces a severe and immediate threat, it will share technology with states facing that same threat. It will pursue an open technology sharing policy if its decisionmakers do not believe sharing technology with the intended recipient will lead to a chance a future adversary will gain the technology. If they believe sharing technology with the intended recipient may lead to a future adversary gaining access to the technology, they will choose a specified technology sharing policy. If a sub-state organization faces a threat to its existence or ability to achieve its core goals, it may share technology with another state if it believes doing so will help ameliorate the threat, but future threat perception still matters. If the organization's decisionmakers believe that sharing technology with the intended recipient may lead a potential future adversary to gain the technology, they will refrain from doing so, unless those decisionmakers believe the pace of innovation is fast enough to minimize any future risks.

The four cases examined generate 25 opportunities to test these predictions, usually on the level of a ministry decisionmaker (see Table 7-1). Of these 25 opportunities, we possess sufficient data to know the actual desired policy of the decisionmaker in 23 of them. TOTT accurately predicts the ministry's or state's preferred technology sharing policy in 17 or about 74%. In three of the observations in which TOTT makes incorrect predictions – all in the Soviet case – technology sharing is more restrained that TOTT predicts, but for reasons TOTT expects should restrain sharing. The possible alternative theories which could explain these decisions do not always generate as specific predictions as does TOTT. If each alternative theory is given one credit for any predictions it makes that can be refined to no more than two of the identified potential technology sharing policies and half credit for any prediction that encompasses three of the potential technology sharing policies, an allowance friendly to the alternatives, no other theory correctly predicts more than 11 of the 23 possible opportunities. Thus, while TOTT does not make perfect predictions, it performs substantially better than any alternative explanations.

Table 7-1: Theory Predictions and Actual Values for Technology Sharing								
			Alternative Theories				*Actual Outcome*	
		Unit of Analysis	*TOTT*	*Structural Realism*	*Economic*	*Organizational*	*Desired*	*Observed*
1	Ch 3 UK-Japan 1920-24	Foreign Office	N	N	Sh	A/Sh	N	M
2		Admiralty	N	N	N	N	N	
3		War Office	N	N	N	N	N	
4		Air Ministry I	M	N	Sh	A	M	
5		Air Ministry II	N	N	Sh	A	N	N
6	Ch 4 UK-US 1917-24	WWI	O	Sh	N	Sh	O	O
7		Post-War: Air Ministry	M	N	A	N/M	M	M
8		Post-War: Admiralty	M	N	N	N/M	M	
9		The Negotiation: Air Ministry	M	N	N	N/M	Sp	M
10		The Negotiation: Admiralty	M	N	N	N/M	M	
11	Ch 5 UK-US 1937-41	Pre-War: Admiralty	N	A	N	N	M	M
12		Pre-War: Air Ministry	N	N	N	N	N	
13		Failure of Appeasement & Phony War: Admiralty	N	A	N	N	M	M
14		Failure of Appeasement & Phony War: Air Ministry	Sp	A	N	N	Sp	

15		Blitzkrieg & After: Admiralty	Sp	Sh	N	N	TBD	O
16		Blitzkrieg & After" Air Ministry	O	Sh	N	N	O	
17	Ch 6 US/UK-USSR 1942-45	To Stalingrad: Britain	Sp	O	N	M	M	M
18		To Stalingrad: U.S.	Sp	Sp	N	M	M	M
19		Stalingrad to Germany: Britain	Sp	Sp	N	M	Sp	To Oct 43: M Oct 43 to Sep 44: Sp
20		Stalingrad to Germany: U.S. to Oct 1943	Sp	Sp/M	N	M	M	
21		Stalingrad to Germany: U.S. after Oct 1943	Sp	Sp/M	N	M. After Feb 1944: Sh	Sp	
22		End Approaches: Britain	Sp	N	N	M	TBD	Sp – no additional technologies released
23		End Approaches: U.S.	Sp	N	N	M	Sp	
24	Ch 6 US-UK 1941-45	U.S. sharing with Britain 1941-1945	O	O*	N	Sh	O	O
25		U.S. sharing with Britain 1941-1945	O	O *	N	Sh	O	
TOTAL CORRECT PREDICATIONS			17	11	3.5	11		

*Decreasing over course of the war

Correct – 1 point | Near Correct – 1 point | Partially Correct – 0.5 points

O – Open Sp – Specified M – Minimal N – None A – Ambiguous. Sh – Share TBD – To be Determined

External Validity

TOTT does relatively well predicting technology sharing policies in the cases examined in this dissertation, but how well should we expect it to do in other circumstances? At least three ways exist in which TOTT may be able to speak to cases not within the scope of the current evaluation.

Across Time

First, to what extent can TOTT help us understand technology sharing in times outside the first half of the Twentieth Century? Can it help us understand technology sharing today? While technology itself has advanced dramatically in the previous seventy years, the processes which underly TOTT have changed to a lesser degree. Innovation if anything is faster. States still worry about their technology falling into the hands of their adversaries. The importance of software to modern weapons makes it harder to keep the technical details of how to create weapons systems more difficult to withhold when making an arms sale. States still threaten each other.

Nonetheless, two factors may be particularly likely to influence TOTT's validity after 1945. The first is the polarity of the international system. TOTT focuses on technology sharing between great powers. It does so for two reasons. First, because usually only great powers can pose severe threats to other great powers. Second, because states must have the capability to innovate or adapt weapons along the technological frontier to maintain their great power status. These criteria matter because they ensure a recipient state can both make use of the technology they are provided and that the recipient could, if its intentions changed, threaten the sharing state. For TOTT, the likelihood that a recipient state may "flip" and become a future adversary of the sharing state places a critical role in restraining technology sharing even in the presence of other threats.

Polarity

Therefore, the polarity of the international system may affect TOTT. Polarity matters because flips are much less likely to occur in a bipolar world than in a multipolar. In a bipolar world, there are only two sides, and those sides are made up of the two great powers. There is nowhere to flip. To the extent that other, lesser great powers exist, however, bipolarity still makes it less likely states will flip. If a lesser power is threatened by one of the great powers, it only has one great power to which it can turn for assistance.

As result, we should expect, for example, that technology sharing should have been more common within the Cold War alliance blocks than it was before the Second World War. The bipolar structure of the international system made it unlikely that Britain or France – both states with the ability to innovate along the technological frontier – would turn against the United States. The institutionalization of the Western Alliance through NATO made flipping even less likely as the European democracies became heavily integrated with and militarily dependent on the United States for their security. Further institutionalization, in the form of the Coordinating Committee for Multilateral Export Controls (COCOM), which coordinated export controls between major non-communist industrialized states in Europe, North America, and the Pacific helped reduce the other half of the "risk that sharing will lead a future adversary to gain technology" variable. Member states could share technology amongst each other with less fear that it might leak to the Soviet Union. While a full evaluation of technology under bipolarity is beyond the scope of this dissertation, these two factors should make technology sharing more common and more liberal within the Cold War alliances blocs than in the earlier part of the century.

While most observers agree that the era of American unipolar power is ending, they debate whether the world seems to be entering an era of bipolarity or multipolarity.[911] Expectations for applicability to the present of TOTT as written depend to some extent on where one falls in this debate, since TOTT presumes a multipolar world. Nonetheless, superficially, TOTT does seem to provide some perspective on ongoing examples – or non-examples – of technical disclosure.

U.S.-India defense cooperation provides a key example. Almost ten years ago, in 2012, the two countries created their Defense Technology and Trade Initiative (DTTI). The Department of Defense says DTTI "elevates [the bilateral] commitment to defense trade, helps eliminate bureaucratic obstacles, accelerates timelines, promotes collaborative technology exchange, strengthens cooperative research, and enables co-production/co-development of defense systems for sustainment and modernization of [bilateral] military forces."[912] This description clearly describes a program that seeks to facilitate technology transfer, but it also alludes to the challenges in making it happen. Indeed, despite high-level biannual talks, and multiple high-level status designations, little real technology sharing has occurred. Rather, every year the same hopeful language appears that movement will come.[913] Only in 2019 did India and the United States sign an Industrial Security Agreement which required Indian firms to protected

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911 Ball, "The Early Stages of a Multipolar World Order"; Kuo, "The Return of Bipolarity in World Politics"; Xuetong, "China, US in Race to Dominate Bipolar World"; Christopher T. Kuklinski, Jeni Mitchell, and Timothy Sands, "Bipolar Strategic Stability in a Multipolar World," *Journal of Politics and Law* 13, no. 1 (2020): 82–88; Charles A. Kupchan and Leslie Vinjamuri, "How to Build an Order," April 29, 2021, https://www.foreignaffairs.com/articles/world/2021-04-15/how-build-order; Haass and Kupchan, "The New Concert of Powers"; Nicu Popescu et al., "The Case Against a New Concert of Powers," May 11, 2021, https://www.foreignaffairs.com/articles/united-states/2021-05-11/case-against-new-concert-powers.

912 Office of the Executive Director for International Cooperation, "US India Defense Technology and Trade Initiative (DTTI)," accessed June 1, 2021, https://www.acq.osd.mil/ic/dtti.html.

913 "Explained: What Is US-India Defence Technology and Trade Initiative," *The Indian Express* (blog), October 19, 2019, https://indianexpress.com/article/explained/explained-us-india-defense-technology-and-trade-initiative-dtti-6077915/; Abhijnan Rej, "US and India Hold Defense Technology Cooperation Meeting Amid Diminished Expectations," accessed June 1, 2021, https://thediplomat.com/2020/09/us-and-india-hold-defense-technology-cooperation-meeting-amid-diminished-expectations/.

classified U.S. technology. And outside analysts see the initiative becoming more about defense sales as efforts to transfer jet engine technology and electromagnetic aircraft carrier catapults have collapsed.[914] TOTT would predict this outcome. Without a significant external threat to the United States or an existential threat to an organization in the U.S. Department of Defense that technology sharing could help ameliorate, a failure to share technology is unsurprising.

Nuclear Revolution

The second factor which could lead to a significant challenge to TOTT's external validity across time is the development of nuclear weapons. Proponents of the nuclear revolution argue that nuclear weapons are a unique technology that, appropriately deployed, stabilize international relations and dramatically decrease the likelihood of conflict between nuclear armed states because they make victory impossible.[915] If the nuclear revolution makes nuclear armed states more secure regardless of the conventional balance of power, states should be more willing to share technology than TOTT would predict because technological shifts should have less effect on a nuclear armed state's security.

On the other hand, while scholars often speak generically of "nuclear weapons," nuclear weapons are part of complicated weapons systems that require the integration of many technologies. Nuclear scholars acknowledge this reality when they speak of the different implications of liquid versus solid fueled missiles versus bombers. The secure second-strike nuclear forces that the nuclear revolution relies upon require many more technologies besides just nuclear fission like missiles – which themselves involve a host of sub-technologies –, guidance systems, and in some cases submarines. Other technologies, like stealth, are not required for secure second-strike forces, but can also advance second (or first) strike nuclear

[914] Rej, "US and India Hold Defense Technology Cooperation Meeting Amid Diminished Expectations."
[915] Robert Jervis, *The Meaning of the Nuclear Revolution: Statecraft and the Prospect of Armageddon*, Cornell Studies in Security Affairs (Ithaca: Cornell University Press, 1989).

capabilities. These technologies all provide advantages to states whether they have nuclear weapons or not.

Whether or not a nuclear revolution exists, a debate outside the scope of this project, we should still expect states to care about the security implications of sharing these nuclear-related technologies. If this is the case, at a minimum we should still expect TOTT to hold for these technologies. Indeed, empirically, we find that the United States has expended significant effort to control technical disclosure of these nuclear-related technologies. Aside from the international nuclear non-proliferation regime, the United States has established the international Missile Technology Control Regime (MTCR).[916] Internally, the United States has created a special bureaucratic process to control the release of any technical information related to stealth or counter-stealth technologies.[917] Thus, the nuclear revolution seems not as much to reduce the potential importance of technology to a state's power, and therefore the care with which it treats technology sharing, but instead it shapes what technologies matter most. In this way, the nuclear revolution is not unique: the advent of gunpowder weapons made sword forging technology less important. Overall, we should still expect TOTT to be able to tell us something about the modern world.

Beyond Great Powers

The second the question we must ask of TOTT is about the extent to which it can tell us about technology sharing with states other than great powers or states that are not in Krause's first or second tier of weapons producers. Scoping TOTT to great powers, which implies first or second tier producer status, is important because it is unlikely that non-great powers will be able to pose significant threats to great powers. As a result, it's unlikely that a non-great power

[916] "Missile Technology Control Regime," MTCR, accessed June 5, 2021, https://mtcr.info/.
[917] "ATTR SSG Senior Decision Reviews," accessed June 5, 2021, https://www.dtsa.mil/SitePages/assessing-and-managing-risk/attr-ssg-senior-decision-reviews.aspx.

flipping on a great power will create the same concern that a great power flipping would. It may, therefore, be that technology sharing with lower tier states or non-great powers is more common than TOTT would otherwise predict. If that were the case, however, TOTT would still expect that the ability of states to protect the technical information they receive from leaking to third states would be an important criterion for sharing.

Fully exploring the applicability of TOTT to less technologically capable states is beyond the scope of this dissertation, but some cursory evidence suggests that the ability of non-great powers to keep secrets matters in whether they receive technological information more so than the risk of flipping and that states may have lower barriers to sharing with non-great power recipients. The United Kingdom regularly undertook technical training and advising missions to lesser powers during the inter-war period.[918] In the early Cold War years, the United States cut off most technical disclosure to Australia during and after a scandal which revealed Communist agents had penetrated the Australian government.[919] Today, the United States is more liberal in sharing much of its technology with Israel, a lesser power with renowned security, than almost any other state. Israel is, for example, the only state the United States allows to have the accesses required to reprogram parts of the F-35's software.[920] What both the discussion of TOTT's potential validity across time as well as its potential validity for technology sharing for lesser powers suggest is that even though TOTT's specific framework for predicting a state or organization's preferred technology sharing policy may not travel, the theoretical variables which underly its predictions do.

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[918] Ferris, "Armaments and Allies."
[919] Chiefs of Staff Committee and Joint Intelligence Committee, "Disclosure of British Military Information to Commonwealth Countries," J.I.C. (48) 127 (Final), 17 December 1948, TNA: DEFE 4/18.
[920] "Why Only Israel Can Customize America's F-35 (At Least for Now)," WIRED, accessed May 18, 2018, https://www.wired.com/2016/05/israel-can-customize-americas-f-35-least-now/.

Implications

This dissertation began with questions about the nature of technology as a component of national power. As TOTT demonstrates, states and sub-state organizations are quite aware of the value technological advantage provides and are often hesitant to share that advantage with other states except in dire circumstances. Even then, they can be careful about what information they provide to others.

This work has implications for our understanding of how states view relative and absolute gains. Examining technology sharing provides special insight on this debate because sharing technology shifts the balance of relative power between the sharer and the recipient without reducing the sharing state's absolute power. This debate between whether states value relative gains or absolute gains is one of the core disagreements between international relations realists and liberals.[921] To the extent one can say scholars have reached a consensus on the subject, it is that states tend to value absolute gains more when the margins between competitors are large and shift to valuing relative gains more as the gap between competing states narrows.[922] If this view were entirely correct, states ought to care the most about their relative position when they face the most severe threats, but this analysis demonstrates the opposite. When states are under the most severe pressure, they become more willing to share technology, especially with

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[921] John W. Kendrick, "The Gains and Losses from Technological Change," *Journal of Farm Economics* 46, no. 5 (1964): 1065–72, https://doi.org/10.2307/1236683; Duncan Snidal, "International Cooperation Among Relative Gains Maximizers," *International Studies Quarterly* 35, no. 4 (December 1, 1991): 387–402, https://doi.org/10.2307/2600947; Robert Powell, "Absolute and Relative Gains in International Relations Theory," *The American Political Science Review* 85, no. 4 (1991): 1303–20, https://doi.org/10.2307/1963947; Michael Mastanduno, "Do Relative Gains Matter? America's Response to Japanese Industrial Policy," *International Security* 16, no. 1 (1991): 73–113, https://doi.org/10.2307/2539052; Samuel P. Huntington, "Why International Primacy Matters," *International Security* 17, no. 4 (1993): 68–83; Joseph Grieco, Robert Powell, and Duncan Snidal, "The Relative-Gains Problem for International Cooperation," *The American Political Science Review* 87, no. 3 (1993): 727–43, https://doi.org/10.2307/2938747.

[922] John C. Matthews, "Current Gains and Future Outcomes: When Cumulative Relative Gains Matter," *International Security* 21, no. 1 (July 1996): 112–46, https://doi.org/10.1162/isec.21.1.112; Matúš Halás, "Post Scriptum on Relative and Absolute Gains," *Perspectives: Review of International Affairs*, no. 1 (2009): 27–55.

states that they do not think are likely to become future enemies. If providing technology to an ally or potential ally helps a state survive, it is likely to do so. In other words, some absolute amount of power is needed to survive, and states will be willing to sacrifice their relative position to survive. While this premise may be unsurprising, it offers an important modification to theories about when relative and absolute gains matter. The relative weighting of the two is U-shaped rather than monotonic. When threats become severe enough, absolute position – and absolute survival – again matter more than relative position.

This dissertation also has implications for the way scholars understand the way decisionmakers think about the implications of their actions across different time horizons. David Edelstein has argued that states discount the future heavily and so are willing to postpone changing policies that will have negative consequences in the future to avoid negative consequences in the present.[923] The research presented here finds that, all else equal, states place more emphasis on the potential future negative consequences of their policies than we might otherwise expect. If even in the dark days of late 1941 and early 1942 Britain was unwilling to consider sharing its technological secrets with the Soviet Union – or for that matter for most of 1942 and much of 1943, and even after that it kept much important information from the Soviets – then it is difficult to imagine the circumstances under which Britain would have disclosed its secrets. This analysis suggests than even in dire circumstances states remain hesitant to permanently augment the power of allies they believe may become future adversaries. It also suggests that states may weigh the potential long-term consequences of their decisions more than we think.

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[923] Edelstein, *Over the Horizon*.

Third, this dissertation has implications for academic arguments about the relative importance of international structural pressures and organizational pressures on the creation of states' foreign policies. It reinforces findings that organizational theory explanations play a significant role in shaping state's policies when threats are low, but that the importance of international factors usually overtakes these organizational pressures when threats are high. I highlight two interesting additions to this debate. First, even in times of low threat – when one would expect organizational interests to dominate, future threats still shape decisions and can play a role in inter-agency bureaucratic struggle. Indeed, threats can be an especially useful argument in organizations and coalitions across agencies as the Admiralty demonstrated when it opposed the Sempill Mission. Second, high threat environments can re-align an organization's incentives. What most benefits an organization in peace is not necessarily what benefits it most in war, especially when looking at an organization's standard operating procedures. In this case, when armed forces are fighting in close collaboration with forces from other states, the incentive to reduce uncertainty through standardization can overpower the desire to keep resources – including technology – to oneself.

Besides its implications for these academic debates, this dissertation has broader implications for the conduct as well as the study of international relations. First, this dissertation reveals the potential value of technology sharing as a form of signaling. Both policymakers and scholars have long understood the value of costly signals. Because talk is cheap, messages mean more when the sender must bear costs to send them. In these cases, if the sender were not serious, he or she would not bear the cost. Because technology sharing means giving a potentially long-term gain, one which the sender cannot claw back, it can serve as a powerful signal. The Tizard Mission's disclosure of the cavity magnetron to the United States helped spark Anglo-American collaboration in more than just technology, in part because it was a costly signal. Of course, the downside of any such effort is that should the receiving state choose not to reciprocate in some way, sharing technology can be quite costly. Another way in which technology sharing can act as a signal is as an early indicator of a deteriorating relationship. If a state which was formally willing to share technology, all else equal, begins to scale back its technology sharing, this action may be an early warning that it sees its interests diverging from those of the recipient. Alternately, as in the Soviet case, tighter controls on technology sharing may indicate that the sharing state was never convinced its long-term interests aligned with those of the recipient.

Second, this examination of technology sharing re-enforces that reciprocation and mutual vulnerability are cornerstones for building trust. The Tizard Mission's costly signal made U.S. officials willing to reciprocate and share their own advanced technology and research. Had this not occurred, the British almost certainly would not have created the ongoing research relationship with the United States that lasted throughout the war. Indeed, it appears one of the quickest ways to end a bi-lateral technology and research relationship – at least outside of war – is to be seen as holding back research equivalent to what is being provided. Belief, whether accurate or inaccurate, that the Americans were holding out on the British or that the Americans did not have much to offer the British helped undermine attempts at technology sharing after the First World War. Similarly, the Soviets' willingness to overpromise and under deliver on the technology they were willing to reveal to the Americans helped foment distrust in the relationship.

Third, as discussed in the introduction, technology is always advancing, so when dealing with similarly technologically advanced states, the worth of one state's technology is always relative. How much any given technological advance is worth is almost always dependent on the technology other states possess and those benchmarks are always changing. The Americans were interested in Soviet synthetic rubber technology, but after more than a year of trying to get access to it, they found that, in that time, they had solved the problems the technology would have helped them with. Had the Soviets provided the technology right away, both they and the Americans would have gained from it. Instead, the episode served only to build mistrust between the two partners.

Indeed, not only is the value of technology relative, but so too is the pace of innovation. Air Ministry officials in the early 1920s believed it "safe" to transfer technology to other states, even potential adversaries, because technology was changing so quickly that what they transferred would soon be obsolete. Put another way, they thought they could innovate quickly enough to maintain their lead. Of course, it was not just the pace of British innovation that mattered, but the pace of innovation of their competitors. Staying "a year ahead" required continuing to innovate at least as fast as competitors even if the overall speed of change meant that the British thought a relatively small lead in innovation could provide significant advantages in capability. And as all these cases show, assessing the speed at which one's own capability will continue to advance can be a challenge, to say nothing of assessing the speed at which another technologically advanced state's research is advancing when it is trying to keep its progress a secret.

Finally, as much as this work has stressed the importance of technology as a source of national power, it highlights that, like any other resource, it is mediated through other factors. A major reason British officials sought to sharing their radar technology with the United States was because the British did not have sufficient secure industrial base capacity to take full advantage of their innovations. Similarly, the Soviet Union's lack of an electronics industrial base made it difficult for it to fully exploit the technology the British and Americans provided during the war.[924]

Especially important in mediating the power of technology is the importance of perception and the human element, as it is in all aspects of international relations. Decisionmakers necessarily make their decision based on the information they have and the perspectives they take on it. Sometimes the information is wrong or the perspectives misguided. The British Air Ministry, at least initially, badly misjudged the consequences of building up Japan's naval aviation capability. During the Second World War, the British and Americans both undertook great efforts at various times to protect the cavity magnetron from disclosure to both the Germans and the Soviets. Ironically, unbeknownst to the British and Americans, both continental states already knew of the technology. When the Germans had their first chance to examine an Allied cavity magnetron after a bomber carrying one crashed in January 1943, the engineers report stated that the operation of the magnetron was already well known.[925]

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[924] Steven Zaloga, "Soviet Air Defense Radar in the Second World War," *The Journal of Soviet Military Studies* 2, no. 1 (March 1, 1989): 104–16, https://doi.org/10.1080/13518048908429935.

[925] In January 1943, the Western Allies authorized the use of the H_2S blind bombing radar, which relied on the cavity magnetron, for using in bombers flying over occupied Europe – the first time the cavity magnetron was used over German occupied territory. Soon one of the bombers crashed, and German engineers examined the radar in detail. Though a self-destruct charge activated, they correctly identified the function of almost every part, including the cavity magneton. The German engineer stated the device appeared to operate on the same principles as a Soviet patent from 1936. Despite this discovery the Germans never pursued more research on the device because engineers were directed to focus on longer wavelength radar. Bernard Lovell, "The Cavity Magnetron in World War II: Was the Secrecy Justified?," *Notes and Records of the Royal Society of London* 58, no. 3 (2004): 283–94. The Soviets were not able to initiate large scale product of microwave radars for multiple reasons including purges of their radar research establishment, the siege of Leningrad – where radar research was concentrated, and the general lack of an electronics industrial base. Zaloga, "Soviet Air Defense Radar in the Second World War."

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Box 137

Atomic Bomb – N.D.R.C. material [1939-1947]

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11356
11707
12523
13248
13966
13968
14756
15520
24226
24263
40789
40988

Department: KV (The Security Service - MI5)

Series: KV 2

871
873

Department: PREM (Premier)

Series: PREM 3

396/1B
475/1
475/4

Department: WO (War Office)

Series: WO 193

306

U.S. National Archives and Records Administration

National Archives Building, Washington, D.C.

Record Group 38: Office of the CNO Division of Naval Intelligence

Entry 81: General Correspondence 1929-1942

<u>Box 199: A8-3/EF12 to A8-3/EF13</u>

A8-3/EF13 England – Information requested by representatives of England-7/9/29 to 3/15/30
A8-3/EF13 Requests for Information – Representatives of Great Britain-3/9/30 to 2/24/31
A8-3/EF13 Information requested by England 3-3/2/31 to 12/28/31
A8-3/EF13 Requests for Information - England 4 -1/16/32 to 2/6/34

<u>Box 200: A8-3/EF13 to A8-3/EF13</u>

A8-3/EF13 Requests for Information – England -3-1-39 to 10-12-39
A8-3/EF13-5-30-36 to 2-25-39
A8-3/EF13 Requests for Information – England -2/21/34 to 3/27/36

<u>Box 201: A8-3/EF12 to A8-3/EF28</u>

A8-3/EF13 (0) Requests for Information – August 7 to Dec 9, 1940
A8-3/EF13/L11-1 Requests of British Govt for info rel to Casualties – USN-30 Jan 41 to 13 Dec 1941
A8-3/EF28 Requests to Exchange Information -France -4-11-32 to 5-23-35
A8-3/EF28-7-29-29 to 4-22-32

<u>Box 229: A10-3/NC3 to A13-3/EF30</u>

A13-1/QN/EF13
A14-5/EF Naval Mission to Foreign Countries

<u>Box 230: A14-1/EG to A14-5/EF</u>

A14-5/EF Naval Mission to Foreign Countries-1/23/31 to 6/27/40
A14-4/EF13

Record Group 80: General Board Studies
Entry 281: Subject File 1900-1947
Box 105: GB 420_14, 1916-1922 to GB 420_14, July 1940
420-14, 1916-1922
Box 168:
438 1922
Box 171: GB 438-1, 1925-1926 to GB 438-1, 1930
438-1 September 1929-1930
Box 173: GB438_2 1931 to GB 439, 1913-1920
G.B. Study No. 438-2 – February 4, 1931 Draft of Treat on Reduction of Armaments
438-2 1931
438-2 1932
438-2 1933

National Archives at College Park, College Park, MD
Record Group 38: Office of Naval Intelligence
Entry UD84: Central Administrative Correspondence 1930-1948
Box 160: A8-3/EF13 (13 Jan 45 to 27 Feb. 1945)
A8-3/EF13 (1945) #2 – 13 Jan 1945 thru 25 Jan 1945
Box 164: A8-3/EF13 (29 June 45 to 13 Aug 45)
A8-3/EF13 #18 '45 – 1 Aug. to 13 Aug 1945
Box 165: A8-3/EF13 (14 Aug 45 to 16 Oct 45)
A8-3/EF13 #20 '45 – 30 Aug. to 25 Sep 1945
Box 166: A8-3/EF13 (17 Oct 45 31 Jan 46)
A8-3/EF13 '46 #1 1 Jan 1946 – 31 Jan 1946
Box 168: A8-3/EF13 (1 May 46- 30 Jun 46)
A8-3/EF13 '46 #7 1May 1946 – 15 May 1946
Entry UD1: Office of the Director Official Correspondence w-DNI/ADI 1934-43
Box 1: Administrative Branch (OP16A/23C/32C)
-No applicable folders
Box 2
-No applicable folders
Box 4: Director's Subject File – (File List)
(Unnamed Folder)
OP-20
ORGANIZATION – ONI Branches/Sections
Contribution to War Effort
(Unnamed Folder with broken red tab)
(Unnamed Folder – two sided)
Personal Memoranda for Director
Box 5: Director's Subject File
Unification Progress
Pearl Harbor Report
Delimitation Agreement
Security Committee
Box 9: Foreign Intelligence Branch Correspondence with Naval Attaches Observes, & Liaison Officers 1930-48 Liverpool to London
London (Nov 27- Oct 33)
London (1933-1939)
London (1940-1948)
Record Group 80: General Records of the Department of the Navy 1798-1947

Entry UD16: Formerly Security -Classified General Correspondence of the CNO/Secretary of the Navy 1940-1947

Box 230: A8-3 to A8-3/EF13 1940-1941 – SECRET

A8-3 –A8-3/EF13 (Aug-1940)
A8-3/EF13 (Sep-Oct 1940)
A8-3/EF13 (Nov-Dec 1940)
A8-3/EF13 (Jan-Apr [1941])
A8-3/EF13 (May-June 1941)
A8-3/EF13 (July-Sep 1941)
A8-3/EF13 (Oct-Nov 1941)

Box 231: A8-3/EF13 to A13-3 1940-1941 – SECRET

A8-3/EF13 (Dec 1941)
A8-3/EF13/OSRD—A8-5/QQ
A13-3(1940)00A13-3(May 41)
A13-3(Jun -Dec 1941)

Box 189: DM/S-1 to EF13-44 1940-1941 Confidential

EE---EF12/QV3
EF13/A6-EF13-42
EF13-44/P8-1 –EF17/P11-1

Box 190:

-No applicable folders

Box 131: S67 1940-1941 Confidential

S67 (Oct-Dec 1940)
S67 (Jan-Mar 1941)
S67 (1-16 Apr 1941)

Box 133: S67 to s67/P11-1 1940-1941 Confidential

S67/A6—S67/P11

Box 135: S67/CV-7 to S67/NB14 1940-1941 Confidential

S67/DD 336 –S67/EW

Record Group 107: Records of the Office of the Secretary of War

NARS A-1 Entry 88: Secretary of War Classified Files 1932-1942, 1937-42

Box 1: Army – Contracts 300

Secret-Army-Navy-British (Minutes of Meetings)

Box 2: Contracts – Muscle Shoals

Industrial Mobilization – Foreign Countries

Box 3: Panama #1 to Philippine Islands

Patents-Secret

Box 4: Puerto Rico & Philippine Islands – Secret 1-450 (1932-1937)

Secret #301 to #450

Box 5: Secret 451 to 850 1937-1940

SECRET #451-590
SECRET #702 to 850

Box 6: Secret 851-1250 (1940)

SECRET #1101 to 1250
SECRET #991 to #1100
SECRET #851 to #990

Box 7: Secret 1251-1950 (1940-41)

SECRET # 1251 to 1400

Record Group 227: Office of Scientific Research and Development

NC-138 Entry 1: Office of the Chairman NDRC & Director OSRD, General Records 1940-47

Box 8 – Division 6 Sub-Surface Warfare
-No applicable folders
Box 9 Division 6 Sub-Surface Warfare
-No applicable folders
Box 26 – Radiation Laboratory Though Liaison Office, London Mission
-No applicable folders
Box 50 – Postwar Planning 1945 – Radar (Reports)
-No applicable folders

NC-138 Entry 2 Office of the Chairman NDRC & Director OSRD Correspondence Re Reports to the President: Reports to the President, 1941-1944:

Box 1
-No applicable folders
Box 3
-No applicable folders
Box 5: Other Miscellaneous Files
General: Reasons on Causes of War
Bush V., - President's Report, "Story Book" [7/41].
NDRC Rpt to FD 7/41
Report to the President [3/42]
Report to the President [9/2/43]
Report to the President [8/44]
A folder of Key Documents pertaining to Various Aspects of the work of OSRD, 1940-43

NC-138 Entry 3: Office of the Chairman NDRC & Director OSRD, NDRC Minutes of Meetings

Box 1 July, 2 1940 – January 17, 1941
Committee Minutes July 2, 1940 File Copy
N.D.R. C. - July 2,1940
Committee Minutes August 29, 1940, File Copy
N.D.R. C. - August 29, 1940
Committee Minutes September 27, 1940, File Copy
N.D.R. C. - September 27, 1940
Minutes of First Meeting of the NRDC
Committee Minutes October 25, 1940, File Copy
N.D.R. C. - October 25, 1940
[Unnamed - Proposals from Division D 11/29/40]
Committee Minutes November 19, 1940, File Copy
IS [Irving Stewart] Nov 29,1940
Committee Meeting January 17, 1941
Minutes of Committee Minutes January 17, 1941, File Copy
Box 2 March 7, 1941 – August 22, 1941
Committee Meeting March 7, 1941
Minutes of Committee Minutes March 7, 1941, File Copy
Minutes of Committee Minutes April 18, 1941, File Copy
Committee Meeting April 18, 1941
Committee Meeting June 12, 1941
Minutes of Committee Meeting June 12, 1941, File Copy
Committee Meeting July 18, 1941
Minutes of Committee Meeting July 18, 1941, File Copy
NRDC Meeting August 22, 1941
NRDC Minutes August 22, 1941, File Copy
Box 3 September 26, 1941 – February 6, 1942
NRDC Minutes September 26, 1941, Approved File Copy
NRDC Meeting September 26, 1941

NRDC Minutes October 31, 1941, Approved File Copy
NRDC Meeting October 31, 1941
National Defense Research Committee November 28, 1941 – File Copy
National Defense Research Committee January 2, 1942 – File Copy
National Defense Research Committee February 6, 1942 – File Copy

<u>Box 4 March 6, 1941 – June5, 1941</u>

National Defense Research Committee March 6, 1942 – File Copy
File Copy NDRC Minutes – April 3, 1942
File Copy NDRC Minutes – May 1, 1942
File Copy NDRC Minutes – June 5, 1942

<u>Box 5 July 2, 1942 – October 15, 1942</u>

File Copy – NDRC minutes, July 2, 1942
File Copy – NDRC minutes, August 7, 1942
Minutes 14th Meeting National Defense Research Committee, September 4, 1942
National Defense Research Committee, October 2, 1942
16th Meeting National Defense Research Committee, October 15, 1942

<u>Box 6 November 6 1942 – January 29, 1943</u>

I.S. National Defense Research Committee November 6, 1942

<u>Box 10 July 9 1943 – October 29, 1943</u>

I.S. National Defense Research Committee July 9, 1943
I.S. National Defense Research Committee July 23, 1943

NC-138 Entry 7 Office of the Historian. 1943-1946. Subject Files

<u>Box 6</u>

Italy, Scientific Mission to
Liaison, Navy
Liaison, Russian Medical
Liaison
Liaison, Great Britain
Liaison, Australia
Liaison Office
Library of Congress
Memorandums from the Chairman's Office

NC-138 Entry 13 Records of the Administrative Office, General Records OSRD

<u>Box 10: Appropriations to Atomic Energy</u>

Atomic Energy
Atomic Energy- Allied Participation
Atomic Energy – Commendations
Atomic Energy – Interim Commission
Atomic Energy – Japanese Cyclotron
Atomic Energy – Legislation
Atomic Energy – Legislation – H.R. Bills, Resolutions & Hearings
Atomic Energy – Legislation – Public Comment
Atomic Energy – Legislation – Special Committee on Atomic Energy

<u>Box 28: Cooperation; A/N Munitions Board to CWS-NRDC Technical Committee (1944)</u>

Cooperation – Atomic Energy Commission
Cooperation – Australia
Cooperation – Office of Censorship

<u>Box 29: Cooperation; CWS-NRRC Technical Committee (1943) to Coordinator of Inter-American Affairs</u>

Cooperation – China

<u>Box 37: Cooperation; Senate to United Kingdom</u>

Cooperation – United Kingdom – British Radar Mission

Cooperation – United Kingdom – Sir Henry Dale's Visit
Cooperation – United Kingdom [Blue]
Cooperation – United Kingdom (Pamphlets)
Cooperation – United Kingdom – BSCO
Cooperation – Canada
Cooperation – United Kingdom [Pink]
Cooperation – United Kingdom - Information Exchange

Box 67: Organization to Patents

Patents 43-44-45
Patents 46-47

Box 68: Patents

Patents - US-UK
Patents - U.S.-UK Agreement
Patents – U.S. – Canada
Patents – GRPP [Government Radar Plant Program]

NC-138 Entry 168 Records of the Liaison Office

Box 1: Policy and Procedure Files
Liaison Office – General Correspondence
AA-1100 H R 4289
AA-1120 1940-1946 British Scientific Organization and Utilization of Scientific Personnel in War Effort
AA-1200 Reports Exchange 1940-1946
AA-1210 1940-1946 Distribution of British Reports
AA-1211 1940-1946 Discontinuance of General Distribution of British Reports
AA-1212 1940-1946 Transfer of British Documents from OSRD files to the Services
AA-1213 1940-1946 Destroying of British Reports in Hands of OSRD Division and Contractors
AA-1220 1940-1946 Distribution of O.S.R.D. Reports
AA-1230 1940-1946 Publication Policies (British)
AA-1232 1940-1946 Declassification and Post-War Publication
AA-1300 1940-1946 Exchange of Scientific Personnel and Visitors
Visitors to BCSO
AA-1310 1940-1946 United Kingdom visitors to United States

Box 8: Policy and Procedure Files AA-1400 Firm to Firm Exchange Plan 1944 to 1946 – AA-1410 Radar Exchange (Company A/B Plan) January to March 1943.

AA-1400 1940-1942 Firm to Firm Exchange Plan
AA-1400 1943 Firm to Firm Exchange Plan
AA-1400 1944-1946 Firm to Firm Exchange Plan
AA-1400 VII.2 Firm to Firm
AA-1400 VII.2b Firm to Firm (Biritish) [sic]
AA-1410 History (Company A/B Plan)

Box 9: Policy and Procedure Files AA-1410 Radar Exchange (Company A/B Plan) January to August 1942 to AA-2320 O.S.R.D. Visitors to Canada 1940-1946

AA-1500 1940-1946 U.S-U.K. Agreement of 8/24/42
AA-1600 1940-1946 Special R.C.M. Channel
AA-2000 1940-1946 Interchange of Technical Information with Canada
AA-2100 1940-1946 Establishment and Basic Policy
AA-2200 1940-1946 Reports Exchange
AA-2220 1940-1946 Distribution of O.S.R.D Reports

Box 10: Policy and Procedure Files AA-3000 to DD-1300

AA-3000 1940-1946 Interchange of Technical Information with Australia
AA-3100 1940-1946 Establishment and Basic Policy
AA-3210 Reports Exchange – Australian U.K.
BB-1000 1940-1946 Interchange of Technical Information with China
BB-1100 1940-1945 Establishment and Basic Policy

BB-1220 1944+45
BB-2000 1940-1946 Interchange of Technical Information with Russia
BB-2100 1940-1946 Establishment and Basic Policy
BB-2220 1940-1946 OSRD Reports to Russia
DD-1100 Organization and Basic Policy 1940-1946
DD-1110 O.S.R.D. (NDRC) as a whole 1940-1946

NC-138 Entry 169 Records of the Liaison Office – Correspondence

Box 26: Correspondence A-1700 British Central Scientific Office August 1944 to 1946

A-1700 To be Filed 1944-43-42-41
A-1700 British Central Scientific Office 1946

Box 29: Correspondence A-1700 British Central Scientific Office January to October 1942

A-1700 British Central Scientific Office January 1942

Box 31: Correspondence A-1914.2 Index of Minutes and Reports from CMR 1940-1946 to A-2700 National Research Council – Canada May-July 1944

-No applicable folders
Patents – Foreign

NC-138 Entry 176 Records of the Liaison Office, London Mission, 1941-1946

Box 128: List of London Mission Files, Return of OSRD Documents

-No applicable folders

Box 128A: London Mission Reports, Part One, Part Two, and Part Three

Part I
Part II

Box 129: London Mission Reports, Part Four through Part Fifteen, History of Radar Exchange (Company A/B) Plan January 1946

Part IX - Radar
Part VII – Sub-Surface Warfare
Part XV [Misc]

Box 130: History Materials

Closing of Distribution of American Reports to British Ministries O.S.R.D
Report on the National Defense Research
Microcosmograhia Academica

Box 131: History Materials

Conant Mission 1941 Box 21A, Item 26
Conant Mission 1941, Box 21A, Item 27

Box 132: History Materials

Post-War Research
History – London Mission

Box 133: Correspondence – London + Washington

List of Flies
Memos from Washington

Box 137: Division Histories

Admiralty
Conant Mission

Box 140: History

Compton Mission
A/B Plan
Archambault Letters to Washington April -Nov 1942

Box 141: History

London Mission Reports
Admin History London Mission + Paris Branch

Whitley Meeting
History Notes
Box 154: Correspondence AA-1200 – Hotel Accommodations
Conant Mission Establishment of London Mission
Admiralty
A/B Exchange
Destroy (Do not destroy)
AA-1312 UK Radar Mission to the US
AA-1200 UK Reports Exchange
Box 166: Memos to Washington
Memos to Washington Sept 1944 – July 1945
Memo to Washington – Radio Sept-Nov 1943
Record Group 298: Office of Naval Research
Entry UD1: Coordinator of Research and Development General Correspondence, 1941-45
Box 1: A1-11a through A-5
A1 Administration & Organization
Membership on Boards A1-4a
General A1-4
Box 10: A5-3
British Ordnance Board Indices A5-3
Box 11: A6-1 through A7-1 (part)
Exchange of Info A7-1
Box 12: A7-1 through A7-4
Exchange of Information Vol II A7-1
Box 19: B1-2
Clearance- General
Box 29: C (EZI-NDRC Divisions A&B)
EZ1/EF13 -NDRC – Exchange of Info. With BRITISH EMPIRE
Box 74: General Secret Files Dispatches (part) - Exchange of Information (Part)
Exchange of Information
Box 75: Exchange of Information (Part) – Foreign Equipment (Part)
Exchange of Information Vol II.

Franklin D. Roosevelt Presidential Library, Hyde Park, NY

President's Secretary File
Series 1: Safe File
Box 2
Vannevar Bush
Box 3
Lord Lothian
Series 5: Subject File
Box 97
Dr. Vannevar Bush
Box 143
National Defense Research Committee
Diaries of Henry Morgenthau
Series 2: Morgenthau Presidential Diaries
No Box Numbers

Presidential Diary Volume 3, May 16, 1940 – February 28, 1941

Foreign Relations of the United States

ProQuest History Vault