NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

"WHAT ABOUT THE AIRSHIP?":
MILITARY INNOVATION, RIGID AIRSHIPS,
AND THE U.S. NAVY (1900–1939)

by

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March 2020

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REPORT DOCUMENTATION PAGE			*Form Approved OMB No. 0704-0188*

1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** March 2020	**3. REPORT TYPE AND DATES COVERED** Master's thesis

4. TITLE AND SUBTITLE
"WHAT ABOUT THE AIRSHIP?": MILITARY INNOVATION, RIGID AIRSHIPS, AND THE U.S. NAVY (1900–1939)

5. FUNDING NUMBERS

6. AUTHOR(S) Casey L. Miller

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release. Distribution is unlimited.

12b. DISTRIBUTION CODE
A

13. ABSTRACT (maximum 200 words)

The U.S. Navy's rigid airship program (1919–1939) represented an innovative attempt to meet the needs of the Fleet in an era of geopolitical uncertainty and rapid technological change. However, when it was over, 105 men of the Navy, including Admiral William A. Moffett, and four of the Navy's five rigid airships, would be lost. Why did the Navy initiate, sustain, and ultimately terminate this controversial program? This thesis answers these questions by analyzing the Navy's pursuit of rigid airships from 1900–1939 through the four paradigms of military innovation studies. In the end, this study reveals that no single paradigm (civil-military, inter-service, intra-service, or socio-cultural) fully explains why the Navy maintained a rigid airship program for so long. The dynamics of all paradigms contributed to innovation, in varying degrees of intensity, at different times, and in different ways. However, the same dynamics that were critical to the rigid airship program's inception and initiation transformed and ultimately led to its termination. This study illustrates the simultaneous interaction and interdependence of the different military innovation paradigms. Ultimately, the best understanding of the forces behind the Navy's rigid airship program comes by synthesizing the different paradigms rather than considering them independently.

14. SUBJECT TERMS
military innovation studies, military history, aviation history, William A. Moffett, Billy Mitchell, P. W. Litchfield, rigid airship, zeppelin, lighter-than-air, interwar innovation, emerging technologies, inter-service rivalry, intra-service rivalry, civil-military relations, civilian intervention, organizational culture, strategic culture, Social Construction of Technology, SCOT, New Institutionalism, emulation, adaptation, public relations, arms control, defense capabilities, procurement

15. NUMBER OF PAGES
151

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	**18. SECURITY CLASSIFICATION OF THIS PAGE**	**19. SECURITY CLASSIFICATION OF ABSTRACT**	**20. LIMITATION OF ABSTRACT**
Unclassified	Unclassified	Unclassified	UU

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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"WHAT ABOUT THE AIRSHIP?": MILITARY INNOVATION, RIGID AIRSHIPS, AND THE U.S. NAVY (1900–1939)

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Submitted in partial fulfillment of the
requirements for the degree of

**MASTER OF ARTS IN SECURITY STUDIES
(STRATEGIC STUDIES)**

from the

**NAVAL POSTGRADUATE SCHOOL
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ABSTRACT

The U.S. Navy's rigid airship program (1919–1939) represented an innovative attempt to meet the needs of the Fleet in an era of geopolitical uncertainty and rapid technological change. However, when it was over, 105 men of the Navy, including Admiral William A. Moffett, and four of the Navy's five rigid airships, would be lost. Why did the Navy initiate, sustain, and ultimately terminate this controversial program? This thesis answers these questions by analyzing the Navy's pursuit of rigid airships from 1900–1939 through the four paradigms of military innovation studies. In the end, this study reveals that no single paradigm (civil-military, inter-service, intra-service, or socio-cultural) fully explains why the Navy maintained a rigid airship program for so long. The dynamics of all paradigms contributed to innovation, in varying degrees of intensity, at different times, and in different ways. However, the same dynamics that were critical to the rigid airship program's inception and initiation transformed and ultimately led to its termination. This study illustrates the simultaneous interaction and interdependence of the different military innovation paradigms. Ultimately, the best understanding of the forces behind the Navy's rigid airship program comes by synthesizing the different paradigms rather than considering them independently.

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LIST OF ACRONYMS AND ABBREVIATIONS

AIC	American Investigation Corporation
BuAer	Bureau of Aeronautics
CinCUS	Commander in Chief, U.S. Fleet
CNO	Chief of Naval Operations
LTA	Lighter-than-air
SCOT	Social Construction of Technology
ZR-1	USS *Shenandoah*
ZR-2	R-38
ZR-3	USS *Los Angeles*
ZRS-4	USS *Akron*
ZRS-5	USS *Macon*

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ACKNOWLEDGMENTS

To my wife, professors, and the lighter-than-air personnel of the War and Navy Departments.

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I. INTRODUCTION: MILITARY INNOVATION AND THE RIGID AIRSHIP

> Within the Navy, airship development has been regarded as a giant experimental project. Frequently it has been criticized as expensive beyond reasonable return for our investment. When other nations faltered and were on the verge of abandoning airship development, we alone had the courage to carry on. I believe we are approaching the time when the public will come to realize that this determination to go forward was based on foresightedness and not visionary dreams.
>
> —David S. Ingalls
> Assistant Secretary of the Navy for Aeronautics (1931)[1]

A. THE PROBLEM: AIRSHIPS AND MILITARY INNOVATION

The Navy's rigid airship program represented an innovative attempt to meet the needs of the Fleet in an era of geopolitical uncertainty and rapid technological change. While the Navy's interest in rigid airships originated before World War I, the program officially began in 1919 and lasted until the scrapping of the Navy's last rigid in 1939.[2] When it was over, 105 men of the U.S. Navy, including Admiral William A. Moffett, and four of the Navy's five rigid airships would be lost.[3] The program's repeated failures to demonstrate the military utility of its airships, and their catastrophic accidents, would seem to indicate that something beyond rational cost-benefit analysis was keeping the program afloat, and indeed, kept it afloat for two decades.

Why did the Navy Department initiate, sustain, and ultimately terminate this controversial program? This thesis examines the U.S. Navy's involvement with the rigid

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[1] Excerpt from *National Aeronautic Magazine* (April 1931) reprinted in Hugh Allen, *The Story of the Airship*, Eighth ed. (Akron, OH: The Goodyear Tire & Rubber Co., 1932), 84.

[2] This study uses 1939 for the program's terminal year. The program was essentially over in 1935 after the crash of the *Macon*. However, the Navy still had the *Los Angeles* and some within the Department attempted to resurrect the program until December 1939 when the *Los Angeles* was scrapped. William F. Althoff, *U.S.S. Los Angeles: The Navy's Venerable Airship and Aviation Technology* (Washington, DC: Brassey's, Inc., 2004), 193–216; Douglas H. Robinson and Charles L. Keller, *"Up Ship!" A History of the U.S. Navy's Rigid Airships 1919–1935* (Annapolis, MD: Naval Institute Press, 1982), 11; Richard K. Smith, *The Airships Akron & Macon* (Annapolis, MD: Naval Institute Press, 1965), 3, 163–70.

[3] Robinson and Keller, *"Up Ship!,"* xiii.

airship from 1900–1939 through the four paradigms of military innovation (civil-military,[4] inter-service,[5] intra-service,[6] and socio-cultural)[7] to identify causal factors that can drive military innovation beyond the point of rational investment.[8] This thesis, through its comparative analysis of the military innovation paradigms, seeks to answer Stuart Griffin's challenge to "re-visit the contending schools of thought about military innovation" to determine "their relative merits as explanatory models."[9]

Fundamentally, however, this thesis finds no individually dominant paradigm among the dynamics of military innovation that can independently explain the rigid airship program's initiation, perpetuation, and termination. However, there is compelling empirical evidence that the dynamics of all paradigms contributed to the program in varying degrees of intensity, at different times, and in different ways. These findings seem to support the existence of what Griffin hypothesized might be the "genuine mutual compatibility" of the paradigms rather than their "deeper incompatibilities and … competition."[10] This thesis demonstrates the fluid interaction, and interdependence, of the different dynamics of military innovation. Lastly, this study also finds that the causes of military innovation can transform into forces that inhibit innovation. For the Navy's rigid

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[4] Barry R. Posen, *The Sources of Military Doctrine: France, Britain, and Germany between the World Wars*, ed. Robert J. Art and Robert Jervis, Cornell Studies in Security Affairs (Ithaca, NY: Cornell University Press, 1984).

[5] A.J. Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam* (Washington, DC: National Defense University Press, 1986).

[6] Stephen P. Rosen, *Winning the Next War: Innovation and the Modern Military*, ed. Robert J. Art and Robert Jervis, Cornell Studies in Security Affairs (Ithaca, NY: Cornell University Press, 1991).

[7] Dima Adamsky, The *Culture of Military Innovation*: The Impact of Cultural Factors on the Revolution in Military Affairs in Russia, the U.S., and Israel (Stanford: Stanford University Press, 2010); Theo Farrell and Terry Terriff, "The Sources of Military Change," in The Sources of Military Change: Culture, Politics, Technology, ed. Theo Farrell and Terry Terriff (Boulder, CO: Lynne Rienner Publishers, Inc., 2002).

[8] Using the competing paradigms to analyze the same problem in an effort to identify which paradigm demonstrates the best causal explanation inspired by Graham Allison and Philip Zelikow, *Essence of Decision: Explaining the Cuban Missile Crisis*, Second ed. (New York: Addison-Wesley Educational Publishers Inc., 1999); Adam Grissom, "The Future of Military Innovation Studies," *Journal of Strategic Studies* 29, no. 5 (2006); Stuart Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," *Journal of Strategic Studies* 40, no. 1–2 (2017).

[9] Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," 218.

[10] Ibid.

airships, the same dynamics that supported the program's initiation and perpetuation eventually transformed into barriers that led to its end. Ultimately, the best understanding of the forces behind the Navy's rigid airship program comes through the synthesis of the different paradigms rather than considering them independently.[11]

B. "WHAT ABOUT THE AIRSHIP?"[12] GAPS IN KNOWLEDGE AND NEW APPROACHES

The U.S. Navy's rigid airship program represents a significant aspect of the Navy's interwar efforts to develop viable aviation capabilities to offset strategic vulnerabilities and adjust to revolutionary changes in the character of war.[13] The topic should generate immense interest within a multidisciplinary audience ranging from historians, to political scientists, to current policy makers. Yet, in comparison to the copious volumes lauding the development of aircraft carriers and carrier aviation, the rigid airship program typically, if mentioned at all, warrants only a few sentences reflecting on its irrationality and inevitable failure. Perhaps the majority of historians and analysts view it as a problematic anomaly or feel it is simply something better left forgotten. Nevertheless, the program remains inextricably intertwined with the Navy's interwar innovation process and played a significant contributing role in shaping the ultimate successful outcome of military aviation.[14] To ignore this case and assume its effects compartmentalized and anomalous would be folly. Fundamentally, the Navy's rigid airship program represents a significant opportunity to analyze an understudied, if not ignored, example of military innovation that influenced an epochal period of American history.

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[11] This is the same conclusion reached by Allison and Zelikow in their study of the different models of foreign policy decision-making (i.e., the combination of models is better than using only one). Whether this is an inevitable outcome of using highly functional competing models on the same case study is open for debate. Allison and Zelikow, *Essence of Decision*, 389–92.

[12] The use of the title of CDR C.E. Rosendahl's 1938 book seems appropriate. Rosendahl continued to be an advocate of rigid airships long after the program's conclusion. Robinson and Keller, "*Up Ship!*," 195; Charles E. Rosendahl, *What About the Airship? The Challenge to the United States* (New York: Charles Scribner's Sons, 1938).

[13] Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*.

[14] Robinson and Keller, *"Up Ship!"*; Smith, *The Airships Akron & Macon*, xiii, 178; Archibald D. Turnbull and Clifford L. Lord, *History of United States Naval Aviation* (New Haven, CT: Yale University Press, 1949).

In addition, researching the interwar rigid airship program exposes alternative approaches and fresh insight into the field of military innovation studies. The bulk of the historical scholarship dedicated to the program predates the emergence of the field of military innovation studies over thirty-five years ago.[15] Accordingly, most accounts are historical narratives that attribute the program's inception and continuation to myriad contributing factors ranging from an American monopoly on global helium production to the Navy's requirement to find a cost-effective solution to a cruiser shortage.[16]

Analyzing the U.S. Navy Bureau of Aeronautics' (BuAer's) tenacious efforts to push the program forward despite repeated failures provides an opportunity to test the explanatory power of the primary military innovation studies paradigms. Currently, the field provides various theories of causality for the sources of military innovation.[17] Yet, some claim the various schools of thought are "conflict averse" and overly reciprocal.[18] Analyzing the interwar airship program through the various paradigms of military innovation forces objective competition in an effort to determine which theory, or facets of each theory, provides the most utility and explanatory power in a relatively unexplored example of military innovation.[19] According to Griffin, conducting such analysis could greatly benefit the field of military innovation studies by "either demonstrat[ing] genuine mutual compatibility, thus increasing the sophistication of our understanding of the relationship between drivers of innovation, or it will expose deeper incompatibilities and inspire greater competition between them."[20] In the end, however, this thesis also aims to be functional. The results directly benefit contemporary policy and decision makers

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15 In his formative article, Grissom explains that the field of military innovation studies came into being with Barry Posen's *The Sources of Military Doctrine* (1984). See Grissom, "The Future of Military Innovation Studies," 906; Posen, *Sources of Military Doctrine*.

16 Douglas H. Robinson, *Giants in the Sky: A History of the Rigid Airship* (Oxfordshire: G.T. Foulis & Co., Ltd., 1973), 182; Smith, *The Airships Akron & Macon*, xix-xx.

17 Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?"; Grissom, "The Future of Military Innovation Studies."

18 This study seems to confirm this belief. Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," 203.

19 Ibid., 218.

20 Ibid.

through illuminating causal mechanisms that were capable of driving an innovating organization beyond the point of rational investment in what appears to have been the wrong technology, at the wrong time, and at great cost in human and financial capital.

C. THE LITERATURE: MILITARY INNOVATION STUDIES

Any attempt to determine the causal mechanisms behind the military innovation process that conceived and perpetuated the U.S. Navy's rigid airship program requires an understanding of the field of military innovation studies and the empirical evidence derived from the history of the program. While the range of military innovation literature is broad and deep, the historical literature dedicated to the Navy's rigid airship program exists in a relatively small, but sufficient, handful of primary and secondary sources. Nevertheless, the historical record provides a variety of potential causal mechanisms across the range of the primary military innovation schools of thought. This section reviews the definition of military innovation, and its core paradigms, in relation to the U.S. Navy's rigid airship program to identify potential hypotheses and gaps in knowledge.

1. Rigid Airships as Military Innovation?

In his seminal article, Adam Grissom defines military innovation as "a change in operational praxis that produces a significant increase in military effectiveness."[21] Theo Farrell offers a simpler definition of "military change" as simply being a "change in the goals, actual strategies, and/or structure of a military organization."[22] While some might argue that the U.S. Navy's rigid airship program failed to achieve a "significant increase in military effectiveness" and should therefore be excluded from further study, the field of military innovation studies is not devoid of examples of failed innovation.[23] Historians agree that the rigid airship program represented a significant potential change in the Navy's

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[21] Grissom, "The Future of Military Innovation Studies," 907.

[22] Farrell and Terriff, "Sources of Military Change," 5.

[23] Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*; Holger H. Herwig, "Innovation Ignored: The Submarine Problem," in *Military Innovation in the Interwar Period*, ed. Williamson Murray and Allan R. Millett (New York: Cambridge University Press, 1996); Elizabeth Kier, "Culture and Military Doctrine: France between the Wars," *International Security* 19, no. 4 (1995).

operational praxis and promised vast increases in efficiency over conventional methods of naval reconnaissance.[24] Accordingly, this study considers the rigid airship program as a viable subject worthy of consideration within the field of military innovation studies.

2. The Military Innovation Paradigms

Also in his article, Grissom identifies the "four primary schools of thought" or "explanatory model[s]" of military innovation.[25] These four paradigms, which imply the primacy of different causal factors of military innovation, include: 1) Civil-military relations; 2) Inter-service competition; 3) Intra-service competition; and 4) Socio-cultural dynamics.[26] Initial research into the U.S. Navy's rigid airship program offers an array of potential causal factors, or dynamics, consistent with the four themes discussed in more detail in the following sections.

a. Civil-Military Relations

The civil-military relations paradigm posits that military organizations are inherently resistant to change and that civilian authorities, recognizing a strategic necessity, often must intervene in order to force militaries to innovate.[27] The civil-military relations paradigm, and the field of military innovation studies, stems from Barry Posen's *Sources of Military Doctrine* (1984).[28] Posen evaluated international relations' organization theory and balance of power theories in order to determine which theory held the greatest power for explaining interwar doctrinal innovation, or lack thereof, in the French, British, and German militaries.[29] Fundamentally, Posen identified "very little internally generated

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[24] Robinson and Keller, *"Up Ship!"*; Smith, *The Airships Akron & Macon*, xxii.

[25] Grissom, "The Future of Military Innovation Studies," 908.

[26] In terms of culture, Grissom states "organizational culture" while Griffin states "cultural influences." Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," 198; Grissom, "The Future of Military Innovation Studies," 908.

[27] Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?"; Grissom, "The Future of Military Innovation Studies"; Posen, *Sources of Military Doctrine*.

[28] Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," 198; Grissom, "The Future of Military Innovation Studies," 908–10; Posen, *Sources of Military Doctrine*.

[29] Posen, *Sources of Military Doctrine*, 7, 34–80.

[military] innovation."[30] Ultimately, Posen found that balance of power theory held greater explanatory power in explaining the cause of military innovation than organization theory. As Posen states, "statesmen will intervene in the doctrines of their military organizations as part of an overall pattern of balancing behavior."[31] Furthermore, Posen asserts, "civilian intervention in military affairs is a key determinant of … innovation."[32] Ultimately, civilian policy makers perceive changes in the international environment, evaluate organic military capabilities and doctrine, and take necessary actions to ensure state militaries innovate in order to ensure state survival.[33]

Some historians provide empirical evidence supporting the civil-military relations paradigm as a potential cause for the creation and continuation of the U.S. Navy's rigid airship program. Namely, multiple sources note that industrial entrepreneurs intervened in order to convince President Warren G. Harding to acquire a rigid airship from Germany following World War I.[34] President Harding, "convert[ed] to the cause of lighter-than-air," directed the State Department and the Department of the Navy to make the acquisition.[35] Additionally, civilian authorities intervened to charge the U.S. Navy with primary responsibility for developing rigid airships and determining their "feasibility … for commercial purposes."[36] Interestingly, in these instances, civilian intervention seems to have been motivated more by potential economic incentives rather than out of a sense of strategic urgency.

However, one of the most dramatic cases of civilian intervention came in the form of the direct intervention of President Calvin Coolidge via the Morrow Board of 1925.[37]

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[30] Ibid., 224.

[31] Ibid., 233–34, 39–41.

[32] Ibid., 233.

[33] Ibid., 233–34.

[34] Ernst Lehmann and Howard Mingos, *The Zeppelins* (New York: J. H. Sears & Co. Ltd., 1927), 325; Robinson and Keller, *"Up Ship!,"* 120.

[35] Lehmann and Mingos, *The Zeppelins*, 325; Robinson and Keller, *"Up Ship!,"* 120.

[36] Robinson and Keller, "*Up Ship!*," 121.

[37] William F. Trimble, *Admiral William A. Moffett Architect of Naval Aviation* (Annapolis, MD: Naval Institute Press, 2007), 162–66.

President Coolidge ordered the board to determine the future of military aviation following the crash of the Navy's rigid airship *Shenandoah* and Brigadier General William "Billy" Mitchell's allegations of incompetence and "criminal negligence" against the War and Navy Departments for their management of military aviation.[38] Ultimately, the board recommended against the creation of an independent air force, revised aviation procurement processes, and supported the continuation of the Navy's rigid airship program.[39] However, one historian specifically dissents stating, "governmental influences did not intervene to save the rigid [airship] either from its later disasters or from competition with heavier-than-air machines."[40]

b. Inter-Service Competition

The inter-service paradigm focuses on the competition between services for resources, and survival, as the primary driver of military innovation.[41] Posen discussed inter-service competition and that services will inherently "fight for [their] own interests" to the point that civilian leadership must intervene to break the counterproductive "treaties and jealousies."[42] However, while Posen puts forth inter-service competition as a causal factor for civilian intervention, others assert that inter-service competition is the direct causal factor for innovation. Notably, A.J. Bacevich explains how the U.S. Army innovated during the 1950s in direct response to the threat other services posed to its continued existence.[43] Fundamentally, the Army innovated and became a radically different nuclear-armed force in direct response to the threat that the U.S. Air Force posed to its mission and survival.[44]

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[38] Ibid., 158–60, 62–66.

[39] Ibid., 165–66.

[40] Henry C. Meyer, *Airshipmen Businessmen and Politics 1890–1940*, ed. Von Hardesty, Smithsonian History of Aviation Series (Washington, DC: Smithsonian Institution Press, 1991), 242.

[41] Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*; Grissom, "The Future of Military Innovation Studies," 910–13.

[42] Posen, *Sources of Military Doctrine*, 226.

[43] Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam.*

[44] Ibid.

Historians repeatedly mention inter-service competition between the Army and the Navy over control of the rigid airship program.[45] Indeed, the sources converge significantly on the very real competition between the Army and Navy, specifically for aviation dominance, publicity, and resources.[46] Admiral Moffett's biographer, William Trimble, supports this thesis as a prime causal reason for the continuation of the rigid airship program. Trimble indicates it likely that the U.S. Navy, and Admiral Moffett as Chief of BuAer, maintained rigid airships merely to deny them to the Army to leverage them as propaganda instruments in the battle for public support.[47] Additionally, Smith notes that as early as 1920, the Navy realized that "if the Navy refused its responsibilities toward the rigid airship, the Army would take them over."[48] Such a result might lead to a loss of public support for naval aviation, the eventual consolidation of all military aviation under the War Department, or worse.[49]

c. Intra-Service Competition

The intra-service competition paradigm asserts that competition between branches of the same service leads to military innovation.[50] Specifically, the different branches of a service engage in what Stephen Peter Rosen refers to as an ideological struggle to develop a new "theory of victory."[51] In these struggles of intra-service dominance, Rosen asserts, senior officers have a monopoly of power by holding control over the "promotion pathway[s]" of rising officers.[52] Control of, or the ability to generate, promotion pathways enables senior or mid-grade officers to ensure that likeminded officers reach higher ranks

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[45] Lehmann and Mingos, *The Zeppelins*; Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*; Trimble, *Admiral W. A. Moffett*.

[46] Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*; Trimble, *Admiral W. A. Moffett*.

[47] Trimble, *Admiral W. A. Moffett*, 14.

[48] Smith, *The Airships Akron & Macon*, 13.

[49] Ibid.

[50] Grissom, "The Future of Military Innovation Studies," 913–16; Rosen, *Winning the Next War*.

[51] Rosen, *Winning the Next War*, 19–20.

[52] Ibid., 20–21.

in order to propagate the new theory of victory and thereby, further the interests of the branch.[53] In addition, rather than intervening to force innovation, civilian leaders merely protect senior officers of their choosing to enable them to gradually achieve the desired innovation.[54]

Historians also note the pervasive presence of intra-service rivalry as a contributing factor to the innovation process of the rigid airship program in the U.S. Navy.[55] Moffett's struggles with the surface fleet admirals to control promotion paths for naval aviators, as noted by Rosen in his work, also included his airship officers.[56] According to Robinson and Keller, Moffett deliberately utilized higher-ranking officers in the rigid airship program "with the aim of having lighter-than-air 'draw more water'" than heavier-than-air.[57] In addition, Moffett had to manage the competing theories of victory within the Bureau of Aeronautics that attributed primary future missions to a variety of aviation assets ranging from heavier-than-air carrier aviation, to flying boats, to airships.[58] Moffett attempted to manage all of this complexity while competing against the battleship admirals for control of promotions for aviation officers in order to further naval aviation as a whole.[59] Beyond personnel issues, intra-service rivalry played an additional role in impeding the integration of rigid airships with the surface fleet by denying the airships opportunities to demonstrate their full capabilities in fleet exercises.[60] Ultimately, the general trend among rigid airship historians is that intra-service rivalry and parochialism played more of a role in countering innovation rather than causing it.

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[53] Ibid., 20–22.

[54] Ibid., 21.

[55] Robinson and Keller, *"Up Ship!"*; Rosen, *Winning the Next War*, 76–80.

[56] Rosen, *Winning the Next War*, 76–80; Turnbull and Lord, *History of U.S. Naval Aviation*, 244–48.

[57] Robinson and Keller, *"Up Ship!,"* 146–47.

[58] Ibid., 177, 94–5.

[59] Ibid., 194; Rosen, *Winning the Next War*, 76–80; Trimble, *Admiral W. A. Moffett*.

[60] Robinson and Keller, *"Up Ship!,"* 171, 84, 86, 94–5; Smith, *The Airships Akron & Macon*, 175.

d. Socio-Cultural Dynamics

The final military innovation paradigm, focusing on socio-cultural dynamics, posits that culture is a major determining factor in when, why, and how military innovation occurs. Farrell and Terriff identify cultural norms as the "intersubjective beliefs about the social and natural world that define actors, their situations, and the possibilities of action."[61] These norms influence how military organizations react to "strategic, political, and technological developments" in the environment.[62] Furthermore, cultural norms can contribute to distinct "strategic culture[s]" that can influence how organizations and national militaries innovate.[63] As Dima Adamsky states, "national military tradition and professional cultures interact with technology, affecting the course and outcome of military change."[64] Others offer that military institutions might choose to emulate the military models of other states out of a desire to enhance their prestige and legitimacy, even when these models are unproven.[65] At the most basic level, some suggest compellingly that socio-cultural dynamics between influential groups, and their competing interpretations of emerging technologies, determine the eventual negotiated form that these technologies will take.[66] According to Grissom, this promising sociological analytical approach, known as the Social Construction of Technology (SCOT), may even allow one to demonstrate that

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61 Farrell and Terriff, "Sources of Military Change," 7.

62 Ibid.

63 Adamsky, *Culture of Military Innovation*, 12.

64 Ibid., 10.

65 Emily O. Goldman, "The Spread of Western Military Models to Ottoman Turkey and Meiji Japan," in *The Sources of Military Change: Culture, Politics, Technology*, ed. Theo Farrell and Terry Terriff (Boulder, CO: Lynne Rienner Publishers, Inc., 2002).

66 Trevor J. Pinch and Wiebe E. Bijker, "The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other," in *The Social Construction of Technological Systems*, ed. Wiebe E. Bijker, Thomas P. Hughes, and Trevor J. Pinch (Cambridge, MA: The MIT Press, 2012), 22–41; Ronald Kline and Trevor J. Pinch, "The Social Construction of Technology," in *The Social Shaping of Technology*, ed. Donald MacKenzie and Judy Wajcman (New York: Open University Press, McGraw-Hill Education, 1999), 113–15.

lower echelons determine the course of military innovation more so than senior military or civilian decision-makers do.[67]

While the majority of historians do not explicitly examine strategic or organizational culture, or the social construction of technology in reference to the Navy's rigid airship program, there is ample empirical evidence to support analysis. Robinson explains that senior naval officers initially identified with the "ponderous and stately [airships]" because they were "like the ships they had grown up with at sea."[68] The rigids were decidedly naval in their construction, mission, operation, and organization.[69] Furthermore, one could argue that a wide variety of social groups, ranging from industrialists, to politicians, to senior military officers, had interests in shaping the rigid airship technology towards their own ends.[70] In addition, examining the strategic culture of the United States, and the organizational culture of the Navy, in the period immediately following World War I might illuminate how culture influenced airship development.[71] This analysis supports an assessment of how culture and the influence of social factors like public opinion, contributed to the initiation, continuation, and eventual termination of the rigid airship program.

D. HYPOTHESES: COMPETING PARADIGMS

While there are other potential, and regularly cited, environmental factors and conditions that contributed to the persistence of the Navy's rigid airship program, this thesis focuses on applying the military innovation paradigms to determine causality. As such, the following hypotheses derive from the core paradigms. They represent the most plausible explanations for the inception and continuation of the U.S. Navy's rigid airship

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[67] Grissom refers to the Social Shaping of Technology (SST), which seems to be the same as the Social Construction of Technology (SCOT) concept from Pinch and Bijker. Grissom, "The Future of Military Innovation Studies," 927; Pinch and Bijker, "Social Construction of Facts and Artifacts," 11–44.

[68] Robinson and Keller, *"Up Ship!,"* 194.

[69] Ibid., 194.

[70] Meyer, *Airshipmen Businessmen and Politics*.

[71] Harold and Margaret Sprout, *Toward a New Order of Sea Power: American Naval Power and the World Scene, 1918–1922*, 2nd ed. (Princeton: Princeton University Press, 1946).

program, despite the loss of over one hundred lives and millions of dollars, until after the crash of the USS *Macon* in 1935.[72] In theory, the qualitative analysis of the historical narrative should support a rational determination of which paradigms provide the most explanatory power.

1. H1: Primacy of Civil-Military Dynamics

If this hypothesis is valid, empirical evidence should indicate that senior civilian authorities, recognizing changes in the strategic environment, forced the U.S. Navy to implement and continue the rigid airship program.[73] There should be clear indications that the Navy sought to resist the continuation of the program and that civilian policy makers overrode the Navy's efforts. Senior civilian decision-makers could include any representatives of the U.S. Government. However, the role of senior civilian industrialists and their influence on elected or appointed U.S. officials is also an important consideration.[74]

2. H2: Primacy of Inter-Service Dynamics

If this hypothesis is valid, empirical evidence should indicate that the competition for resources between the Navy and War Departments was the primary deciding factor in the Navy's continuation of the rigid airship program.[75] This competition is a well-documented contributing factor to the Navy's reluctance to terminate the program.[76] However, it requires further analysis to determine whether inter-service competition, more so than any other factor, drove the program forward despite its continued failures.

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[72] Robinson and Keller, *"Up Ship!,"* xiii; Smith, *The Airships Akron & Macon*, 147–62.

[73] Grissom, "The Future of Military Innovation Studies"; Posen, *Sources of Military Doctrine*.

[74] Lawrence Jacobs and Benjamin Page, "Who Influences U.S. Foreign Policy?," *The American Political Science Review* 99, no. 1 (2005): 21; Burl Noggle, *Teapot Dome: Oil and Politics in the 1920s* (Baton Rouge: Louisiana State University Press, 1962).

[75] Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*; Grissom, "The Future of Military Innovation Studies."

[76] Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*; Trimble, *Admiral W. A. Moffett*; Turnbull and Lord, *History of U.S. Naval Aviation*.

3. H3: Primacy of Intra-Service Dynamics

If this hypothesis is valid, evidence will demonstrate that senior Navy officers, protected by civilian leadership, furthered a new theory of victory by developing new promotion paths for rigid airship officers and this contributed fundamentally to the continuation of the program.[77] While it is clear from Rosen and Robinson's works that Admiral Moffett did exactly this, it is unclear what contribution this made to the continuation of the rigid airship program. If civilian leadership protecting Moffett enabled him to keep the program alive in the face of intra-service resistance, then this hypothesis might prove compellingly valid.

4. H4: Primacy of Socio-Cultural Dynamics

If this hypothesis is valid, evidence will indicate that: 1) the strategic culture of the United States; 2) the organizational culture of the U.S. Navy; or 3) the interests and interaction of influential social groups fundamentally enabled the program to continue despite its early failures.[78] Supporters of the socio-cultural paradigm typically halt short of "ascribing independent causal power to cultural factors."[79] However, their reluctance does not definitively prove that socio-cultural factors lack the power to function as causal mechanisms in military innovation.

E. METHODOLOGY

This study analyzes three phases of the rigid airship program's life cycle: 1) the Inception and Initiation Phase (1900–1919); 2) the Experimentation and Development Phase (1920–1928); and 3) the Employment and Termination Phase (1929–1939). This study collates and analyzes the empirical evidence from each phase, by military innovation paradigm, to determine which dynamics provide causal explanations for the program's

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[77] Grissom, "The Future of Military Innovation Studies"; Rosen, *Winning the Next War*.

[78] Adamsky, *Culture of Military Innovation*; Farrell and Terriff, "Sources of Military Change"; Grissom, "The Future of Military Innovation Studies"; Pinch and Bijker, "Social Construction of Facts and Artifacts."

[79] Adamsky, *Culture of Military Innovation*, 10–11; Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," 204.

inception, perpetuation, and termination. Alison and Zelikow's method in *Essence of Decision* utilizing competing paradigms to examine the same event provides the general inspiration for this framework of comparative analysis.[80]

1. Inception and Initiation Phase (1900–1919)

First, this thesis focuses on collecting empirical evidence on airship development from 1900–1919 in order to build a coherent understanding of how the military employment of rigid airships developed. Research attempted to determine how the United States military viewed rigid airships and their potential usefulness up until the end of World War I. Evidence pre-1919 supports building an understanding of the popular perceptions, both civil and military, of the rigid-type airship that encouraged the program's initiation. Ultimately, the objective of this first phase of analysis is to determine exactly when, how, and why the U.S. Navy became committed to the concept of initiating a rigid airship program.

2. Experimentation and Development Phase (1920–1928)

Second, this section focuses on the U.S. Navy's rigid airship program from 1920–1928 and reviews the performance of the Navy's first three rigids leading up to the destruction of the *Shenandoah* (1925).[81] This phase concludes with the Navy Department securing contracts for the construction of the *Akron* and *Macon* in 1928.[82] Additionally, this study examines the key events during this timeframe such as the Joint Army-Navy Board of 1920, the Washington Naval Conference (1921) and the boards and inquiries of 1925 following the *Shenandoah* disaster.[83] Furthermore, this section analyzes parallel advances in naval aviation that may have rendered the continuation of the rigid airship program unnecessary. The climacteric events of 1925 provide the most compelling

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[80] Allison and Zelikow, *Essence of Decision*.

[81] Robinson and Keller, *"Up Ship!,"* 104–13.

[82] Smith, *The Airships Akron & Macon*, 18.

[83] Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*; Sprout, *Toward a New Order of Sea Power*; Turnbull and Lord, *History of U.S. Naval Aviation*.

evidence enabling the identification of the causes for the continuation of the program beyond its logical termination point.

3. Employment and Termination Phase (1929–1939)

Third, the thesis analyzes the final phase of the program and its apogee with the aerial aircraft carriers *Akron* and *Macon*.[84] This phase concludes with the termination of the program and the scrapping of the Navy's last rigid airship, the *Los Angeles*, in 1939.[85] Key events during this phase include fleet exercises, the terminal accidents of the *Akron* and *Macon*, and the resulting social, political, and military aftermath. The goal of this phase of analysis is to determine which dynamics of military innovation contributed most prominently to the end of the U.S. Navy's rigid airship program.

F. SOURCES AND APPLICATION

This thesis relies on an array of secondary and primary sources. Pivotal secondary sources like Robinson's and Smith's rigid airship histories provide expert analysis, significant amounts of embedded primary material, and enable the identification of primary source records and dates of key, and potentially causally significant, events.[86] Furthermore, the biographies and autobiographies of key individuals, such as Admiral Moffett, P.W. Litchfield, Hugo Eckener, President Harding, and others build an understanding of the relationships, interactions, and motivations of those involved in military and industrial policy making.[87] In addition, this study leverages multiple works

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[84] Smith, *The Airships Akron & Macon*.

[85] Althoff, *Los Angeles*, 193–216.

[86] Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*.

[87] Hugo Eckener, *My Zeppelins*, trans. Douglas H. Robinson (London: Putnam & Co. Ltd., 1958); P.W. Litchfield, *Autumn Leaves: Reflections of an Industrial Lieutenant* (Cleveland: Corday & Gross Co., 1945); Eugene P. Trani and David L. Wilson, *The Presidency of Warren G. Harding*, ed. Clifford S. Griffin, Donald R. McCoy, and Homer E. Socolofsky, American Presidency Series (Lawrence: University Press of Kansas, 1977); Trimble, *Admiral W. A. Moffett*.

published by contemporaries directly involved in the airship's innovation process.[88] These artifacts help further build the base of empirical evidence by examining the perspectives of those who lived through the program's development. Finally, official records and reports of the Navy Department and the Bureau of Aeronautics, as available, were important sources of statistics and official policy regarding the program and the Navy in general.

G. THESIS OVERVIEW

This thesis is arranged in order to establish context, present the empirical evidence, and evaluate the various hypotheses for causality. In the following chapters, this study proceeds through the phases of the U.S. Navy's rigid airship program analyzing each phase for causality in terms of the four military innovation paradigms and their associated dynamics. Chapter II assesses the program's inception and initiation phase (1900–1919) and presents empirical evidence and analysis explaining why the U.S. Navy initiated a rigid airship program. Chapter III analyzes evidence from the rigid airship's experimentation and development period (1920–1928) to determine which military innovation paradigms provide the best causal explanation for the continuation of the program beyond 1925. Chapter IV examines the rigid airship program from 1929 until its eventual termination in 1939 with analysis of the factors that led to its end. Finally, in Chapter V, the thesis concludes with a review the military innovation paradigms and their ability to explain the initiation, perpetuation, and termination of rigid airship development in the Navy. Chapter V also provides this study's implications for the development of the field of military innovation studies, and the airship, in the future.

H. SUMMARY

The object of this thesis is to determine what causal mechanisms, in terms of the dynamics of military innovation, were behind the inception, perpetuation, and termination

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[88] R.P. Hearne, *Airships in Peace and War: The Second Edition of Aerial Warfare* (London, The Bodley Head: John Lane, 1910); Lehmann and Mingos, *The Zeppelins*; P.W. Litchfield, Industrial Voyage: My Life as an Industrial Lieutenant (Garden City, NY: Doubleday & Co., Inc., 1954); P.W. Litchfield and Hugh Allen, *Why? Why Has America No Rigid Airships?* (Cleveland: Corday and Gross Co., 1945); Charles E. Rosendahl, *Up Ship!* (New York: Dodd, Mead and Co., 1931); *What About the Airship*; Harry Vissering, *Zeppelin: The Story of a Great Achievement* (Chicago: Harry Vissering, 1922).

of the U.S. Navy's rigid airship program. This study does not conduct a detailed technical evaluation of rigid airships, nor is it intended to make a normative argument for or against lighter-than-air technology. Furthermore, the research objective is not to determine the widest possible array of contributing environmental factors and conditions. However, this study did seek to collect a wide array of evidence in order to prove/disprove the proposed hypotheses.

Ultimately, this thesis finds that the aggregation of the dynamics of military innovation (H1-H4) seemed to support, or inhibit, the rigid airship program more so than any dynamic acting individually. Additionally, this thesis found that military innovation causal factors did not remain constant throughout the program's life cycle and that they shifted with time and circumstances. Dynamics that once supported the program eventually turned against it. Accordingly, it became apparent during analysis that aspects of each hypothesis proved to be more valid at different phases in the program's timeline. As a result, this study evaluates the sequencing, and magnitude of influence, of the actions and events supporting each hypothesis to determine its individual causal impact by phase.[89]

In the end, the combination of paradigms enabled a thorough understanding of the driving forces behind the U.S. Navy's rigid airship program and its termination.[90] All dynamics played instrumental roles at different times in the initiation, perpetuation, and termination of the program from 1900–1939. Accordingly, this thesis also illustrates the interdependence and interaction of the military innovation paradigms, and their associated dynamics. The results provide incentive to develop further frameworks for the comparative or integrated analysis of the paradigms of military innovation for future research.

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[89] Andrew Bennett and Jeffrey Checkel, "Process Tracing: From Philosophical Roots to Best Practices," in *Process Tracing: From Metaphor to Analytic Tool*, ed. Andrew Bennett and Jeffrey Checkel (Cambridge: Cambridge University Press, 2015); Deborah Larson, "Sources and Methods in Cold War History: The Need for a New Theory-Based Archival Approach," in *Bridges and Boundaries: Historians, Political Scientists, and the Study of International Relations*, ed. Colin Elman and Miriam F. Elman (Cambridge, MA: The MIT Press, 2001), 334–35.

[90] Again, the conclusion that the combination of competing paradigms provides enhanced explanatory value is the same conclusion Allison and Zelikow reached. However, their foreign-policy decision-making models and the paradigms of military innovation are distinctly different. Allison and Zelikow, *Essence of Decision*.

II. OBSERVATION, INCEPTION, AND INITIATION (1900–1919)

> It was Themistocles who declared that "he who shall make himself master of the sea is destined to become master of the land." Now if the ocean has given this power to the nation which was wise enough to seize it, how much greater will be the coming mistress of the air?
>
> —Professor Pierre Janssen
> President, International Aeronautic Congress, Paris (1901)[1]

A. INTRODUCTION

The period from 1900–1919 represents the incipient phase of the U.S. Navy's rigid airship program in which the dynamic interaction of internal and external forces propelled the Navy towards the program's initiation after World War I. This chapter ultimately finds that while civilian intervention demonstrated limited, if any, influence on the Navy's initiation of a rigid airship program, the other military innovation dynamics contributed significantly. From 1900–1919 a combination of intra-service, inter-service, and particularly socio-cultural dynamics drove the Navy to initiate its twenty-year rigid airship program.

Before analysis of the individual hypotheses can proceed, however, it is necessary to review briefly the history of Germany's zeppelins to provide a contextual understanding of the rigid airship's origins and early performance. World powers increasingly experimented with dirigible, or "directable," balloons since the advent of small and efficient liquid-fueled internal combustion engines in the 1880s.[2] However, advances in the weight and power of the engine enabled epochal changes in the field of aviation in the

[1] Janssen was also an astronomer and director of the French Astrophysical Observatory. He, along with Joseph Lockyer, discovered the element Helium in 1868. Quote in Wellman. Walter Wellman, *The Aerial Age: The Past, the Present, and the Future of Aerial Navigation* (New York: A.R. Keller & Co., 1911), 443; Wheeler M. Sears Jr., *Helium: The Disappearing Element*, Springerbriefs in Earth Sciences (New York: Springer International Publishing AG, 2015), 41–46.

[2] The first airship flight using an internal combustion engine occurred in Germany in 1888. Robinson, *Giants in the Sky*, 2–3; Wellman, *The Aerial Age*, 226.

first two decades of the twentieth century.[3] Capitalizing on this technology, new materials, and a radical departure from contemporary lighter-than-air design, Count Ferdinand von Zeppelin conducted the first successful flight of the "rigid" airship in 1900 at Lake Constance in Friedrichshafen, Germany.[4] The rigid airship was not simply a steerable balloon like earlier dirigibles. The rigid was distinct from existing airships due to its "hull of latticed girders running longitudinally and transversely, braced by steel wire tension."[5] This internal metallic structure contained the ship's separate gas cells and gave its envelope its iconic elongated shape.[6] The word "zeppelin" would become synonymous with the rigid airship. Due to its innovative design, the new craft had drastically superior lift capacity, endurance, and operational range in comparison to its heavier-than-air counterparts for decades to come.[7]

Germany employed these "secret weapons of Teutonic air superiority" against the Allies in World War I (1914–1918) for strategic reconnaissance and bombardment.[8] However, the zeppelins failed to achieve the decisive results that the Germans anticipated. Of the 121 German rigid airships operated from 1914–1918, 79 (65.3%) were lost to enemy action or accidents resulting in the deaths of over 410 personnel.[9] Evolving British air defenses forced the zeppelins to fly at increasingly higher altitudes rendering the Germans' primitive navigational and bombing methods even more inaccurate.[10] By comparison, English rodents caused £24,000,000 more in damages annually than the entirety of

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[3] Hearne, *Airships in Peace and War: The Second Edition of Aerial Warfare*, xiv; Robinson, *Giants in the Sky*, 3.

[4] Robinson, *Giants in the Sky*, 25–26.

[5] Charles P. Burgess, *Airship Design* (New York: The Ronald Press Company, 1927), 3–5.

[6] Ibid.; Robinson, *Giants in the Sky*, 9.

[7] "Heavier-than-air" refers to any aircraft that does not generate lift from a lighter-than-air gas (i.e., the airplane). Robinson and Keller, *"Up Ship!,"* xi.

[8] Robinson, *Giants in the Sky*, 83.

[9] Robinson's lists of rigid airship data, compiled from German war records, do no not list all personnel killed. Some ships (i.e. LZ107) list "no survivors" without providing the actual number of crew killed or captured. Of the ships lost there were also 125 personnel listed as captured. Robinson, *The Zeppelin in Combat* (Atglen, PA: Schiffer Publishing, Ltd., 1994), 385–98; *Giants in the Sky*, 330–39.

[10] Robinson, *Giants in the Sky*, 84–143; Robinson, *The Zeppelin in Combat*.

Germany's strategic bombing efforts during the war.[11] Furthermore, the German zeppelins were only capable of operating 25.6% of the time, or 399 out of 1,559 days, from 1914 to 1918 in performance of their reconnaissance duties in support of the German Navy.[12] The cause of this degraded performance was generally the weather.[13] According to zeppelin commander Ernst Lehmann, "in the latter half of the war, the airplanes obtained equally, and often more, effective results than the Zeppelins had been able to accomplish earlier."[14] In the end, Germany, and Count Zeppelin himself, turned to the airplane.[15] Yet before, during, and after the war the United States Navy remained fixated on German airship technology and the potential of rigid airships, particularly in their naval applications.

This chapter's purpose is to uncover why the United States Navy initiated a rigid airship program in 1919 by analyzing the early years of rigid airship development from an American naval perspective and through the military innovation paradigms. Empirical evidence is grouped within the core military innovation paradigms focusing on: 1) Civil-military dynamics;[16] 2) Inter-service dynamics;[17] 3) Intra-service dynamics;[18] and 4) Socio-cultural dynamics.[19] In the end, evidence indicates that while civilian intervention did occur, it was too weak to overcome the internal bureaucratic resistance of the Navy Department. However, there is strong empirical evidence indicating that the fluid interaction of intra-service, inter-service, and socio-cultural dynamics drove the U.S. Navy

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[11] J.F.C. Fuller, however, felt that their psychological and morale-destroying effect grossly outweighed the financial sum of their physical destruction. J.F.C. Fuller, *Machine Warfare* (London: Hutchinson & Co., Ltd., 1941), 87–88.

[12] Robinson, *The Zeppelin in Combat*, 373; Robinson and Keller, *"Up Ship!,"* 193.

[13] Lehmann and Mingos, *The Zeppelins*, 105, 303–04; Robinson, *The Zeppelin in Combat*, 373.

[14] Lehmann and Mingos, *The Zeppelins*, 262.

[15] Hugo Eckener, *Count Zeppelin: The Man and His Work*, trans. Leigh Farnell (London: Massie Publishing Co., Ltd., 1938), 274; Lehmann and Mingos, *The Zeppelins*, 260; Robinson, *Giants in the Sky*, 136–7.

[16] Posen, *Sources of Military Doctrine*.

[17] Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*.

[18] Rosen, *Winning the Next War*.

[19] Adamsky, *Culture of Military Innovation*; Farrell and Terriff, "Sources of Military Change"; Goldman, "Spread of Western Military Models"; Grissom, "The Future of Military Innovation Studies," 908–18.

to initiate a rigid airship program. According to airship historian Douglas Robinson, "the hydrogen-inflated rigid airship ended World War I completely discredited as a combat weapon, even in Germany … only the United States would procure them in the future for military purposes."[20] This chapter aims to establish what led to this American procurement decision, in order to inform analysis in later chapters regarding: 1) why the United States continued the program even when it failed to live up to expectations; and 2) what forces ultimately terminated the rigid airship's innovation cycle.

B. CIVIL-MILITARY DYNAMICS: WEAKNESS AND RESISTANCE

While there were several instances of civilian intervention in naval policy in the first two decades of the twentieth century, these interventions had only tertiary impacts on the United States Navy's ultimate decision to pursue a rigid airship program in 1919. Policy makers were largely content with the U.S. Navy's battleship-centric "offensive sea control" doctrine as the best means to protect national interests and security.[21] From the Spanish-American War (1898) to World War I this "navalism," and the battleship, continued to dominate the global maritime security environment and, consequently, American procurement decisions.[22] Accordingly, from 1900–1919, civilian and military decision-makers prioritized fleet construction over investment in emerging technologies like the rigid airship and, more generally, naval aviation.[23] Nevertheless, some senior civilians and military personnel did see the potential of integrating aviation with the Fleet, and encouraged change within the Navy Department. Ultimately, however, these intermittent, half-hearted attempts failed to produce significant change in the face of rigid bureaucratic resistance from within the Navy.

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[20] Robinson, *Giants in the Sky*, 142.

[21] George W. Baer, *One Hundred Years of Sea Power: The U.S. Navy*, 1890–1990 (Stanford: Stanford University Press, 1994), 9–26; Sprout, *Toward a New Order of Sea Power*.

[22] Baer, *One Hundred Years of Sea Power*, 27–48; Sprout, *Toward a New Order of Sea Power*; Fareed Zakaria, *From Wealth to Power: The Unusual Origins of America's World Role* (Princeton: Princeton University Press, 1998).

[23] Baer, *One Hundred Years of Sea Power*, 27–93; Turnbull and Lord, *History of U.S. Naval Aviation*, 1–175.

The earliest intervention in favor of naval aviation came at the request of Assistant Secretary of the Navy Theodore Roosevelt in 1898.[24] Roosevelt, following the aeronautical experiments of Professor Samuel Pierpont Langley, encouraged the Navy Department to assess "whether [the airplane] will not work on a large enough scale to be of use in the event of war."[25] Consequently, representatives from the Army and Navy formed the "Langley Board" to assess whether investment in aviation related capabilities could support the Services.[26] The Board determined that the airplane did indeed demonstrate great potential for enhancing reconnaissance, communications, and offensive operations.[27] The results passed from the Secretary of the Navy to the Navy's Board of Construction.[28] The Board of Construction, however, refused to participate stating that, "such an apparatus as is referred to pertains strictly to the land service and not to the Navy," accordingly, "[it is] not expedient at this time for the Navy Department to carry on experiments or furnish money for the purpose."[29] This would be the first, of several, instances of organizational resistance against civilian intervention in favor of naval aviation.

The Navy's progress in aviation, even after significant developments in aeronautics domestically and abroad, crept along at a glacial pace from 1910–1916. There was little indication that civilian authorities were significantly concerned with the Navy's lack of emphasis on aviation. By 1912, the Navy had only three aircraft and Congress authorized the Department to spend $65,000 on aviation-related activities compared to $15,472,619.67 appropriated for ship construction.[30] However, the Navy Department split the money between three of its Bureaus that ultimately spent less than 30% of the aviation-

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[24] Turnbull and Lord, *History of U.S. Naval Aviation*, 1–2.

[25] Ibid., 1.

[26] Ibid., 1–2.

[27] Ibid., 2.

[28] Ibid.

[29] Ibid.

[30] George L. Meyer, "Annual Reports of the Navy Department (1912)," ed. Navy Department (Washington, DC: Government Printing Office, 1913), 224; Turnbull and Lord, *History of U.S. Naval Aviation*, 21–22.

related appropriation.[31] By 1913, the Navy's aerial fleet had grown to eight aircraft and 13 officers.[32] By 1914, the United States Army and Navy had only 19 airplanes combined, with no dirigibles, in comparison to Germany's 500 airplanes and 20 zeppelins.[33] The United States was only ahead of Japan and Spain in terms of heavier-than-air platforms while every other great power fielded at least one dirigible.[34] With war commencing in Europe in August of 1914, and America's abysmal military aviation condition, it seemed an appropriate time for civilian intervention.

However, civilian intervention did not occur until 1915, and it came in relation to the annual Naval Appropriations Act. Congressman Ernest W. Roberts of Massachusetts, and others, insinuated that the pacifistic tendencies of Secretary of the Navy Josephus Daniels had undermined the readiness of the Navy Department and naval aviation in particular.[35] Roberts specifically mentioned the Navy Department's "slowness … in going into aeronautics" and did not foresee any significant changes "unless they are pushed from this end."[36] Congress provided the Department of the Navy with $1,000,000 for aviation and dictated that Secretary Daniels personally handle its allocation towards aviation without distributing it to the Bureaus where it would surely fail to be utilized.[37] Furthermore, Congress authorized President Woodrow Wilson to establish the interagency National Advisory Committee for Aeronautics "to supervise and direct the scientific study of the problems of flight … to determine the problems which should be experimentally attacked … and to discuss their solution and their application to practical questions."[38]

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[31] Turnbull and Lord, *History of U.S. Naval Aviation*, 21–22, 46.

[32] Ibid., 29.

[33] Ibid., 40.

[34] The other great powers monitored by the Office of Naval Intelligence included Germany, France, Great Britain, Russia, Italy, Austria-Hungary, Belgium, Japan, and Spain. Ibid.

[35] Ibid., 46.

[36] Ibid.

[37] Ibid., 46–47.

[38] Ibid., 48–49.

Secretary Daniels and the first Chief of Naval Operations (CNO), Admiral William S. Benson, responded by: 1) placing the "officer-in-charge" of aviation under the supervision of the Material Division within the Office of Naval Operations; 2) ordering him to provide advice on aviation matters only "as required;" 3) distributing the aviation funds among the bureaus in contradiction to congressional direction; 4) failing to designate a Navy Department liaison to the National Advisory Committee for Aeronautics as directed; and 5) leaving no individual tasked with, or authorized to, coordinate development of naval aviation within the Navy Department.[39]

In 1916, with President Wilson's policy transition from strict neutrality to "preparedness," the civilian attempts to compel naval aviation readiness continued.[40] Wilson authorized the creation of a Naval Flying Corps, which the Navy never implemented.[41] Aviation planners within the Navy Department asked for $13,000,000 to prepare naval aviation for war.[42] Secretary Daniels and CNO Benson reduced the request to $2,000,000.[43] Congress voluntarily raised the appropriation to $3,500,000.[44] The Aero Club of America, a civilian organization of aviation enthusiasts intent on training an aerial militia, offered to raise private funds for the Navy to support the development of naval aviation.[45] Secretary Daniels refused as it was against policy to accept funds from private parties.[46] Accordingly, the Navy's aviation elements entered World War I undermanned and underequipped necessitating rapid expansion.

During the War, naval aviation's ranks and budget drastically increased thanks to civilian policy makers and wartime necessity, however, reaction does not equal intervention. In early 1917, the Navy and United States Marine Corps had only 14 qualified

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[39] Ibid., 55.

[40] Baer, *One Hundred Years of Sea Power*, 49–62.

[41] Turnbull and Lord, *History of U.S. Naval Aviation*, 81.

[42] Ibid., 82.

[43] Ibid.

[44] Ibid.

[45] Ibid., 93–95.

[46] Ibid., 93.

pilots with a total of 56 officers on flight status.[47] By war's end, naval aviation included 6,716 officers and 30,693 enlisted men.[48] Of these, approximately 170 were trained to operate lighter-than-air craft.[49] As the United States entered the war, Congress increased spending on naval aviation to a total of $6,500,000 for 1917.[50] Congress, realizing more was needed, authorized an additional $11,000,000 in June 1917, and a further $45,000,000 in October 1917 as part of the Deficiency Act of 1917.[51] While the Navy fliers performed admirably, both heavier-than-air and lighter-than-air, the war ended as "all hands were just getting into fighting condition."[52] The Navy, rather optimistically, anticipated having $225,000,000 for its FY 1920 aviation budget.[53] After the war ended, however, they would be disappointed.

At the conclusion of hostilities the Navy Department and Congress immediately implemented rapid demobilization and austerity measures.[54] Naval aviation fell to the bottom of the Navy's priorities and Congress did not attempt to intervene. Yet, somehow, a rigid airship program rose from the ashes of the fight over the budget. The Naval Appropriations Act of 1919, despite cutting aviation appropriations from $225,000,000 to $25,000,000, specifically authorized the Navy Department to procure two rigid airships out of the four "Zeppelins" aviation planners requested.[55] The Navy Department would purchase one from England and would build one domestically in the years ahead.[56] The Naval Appropriation Act of 1919 also authorized the creation of a Naval Air Station at

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[47] Ibid., 89–90.

[48] Ibid., 105.

[49] Ibid., 117.

[50] Ibid., 107.

[51] Ibid., 106–07.

[52] Ibid., 140.

[53] Ibid., 155.

[54] Robinson and Keller, *"Up Ship!,"* 10; Turnbull and Lord, *History of U.S. Naval Aviation*, 147, 63.

[55] William F. Althoff, *Sky Ships: A History of the Airship in the United States Navy* (New York: Orion Books, 1990), 3; Robinson and Keller, *"Up Ship!,"* xii, 10–11; Turnbull and Lord, *History of U.S. Naval Aviation*, 155–56, 72–73.

[56] Robinson and Keller, *"Up Ship!,"* 11.

Lakehurst, New Jersey for the new rigids.[57] Yet, it does not seem that the impetus to initiate a rigid airship program came from civilian leaders. Indeed, as Robinson and Keller note, in dealing with Congress, "naval officers … had to cope with the ignorance and suspiciousness of economy-minded congressmen … who knew very little about the Navy, and nothing at all about rigid airships."[58] Clearly, simply providing funds in response to military requests does not qualify as an intervention. In reality, the initiation of the rigid airship program seems to have come more from other sources than it did from civilian authorities.

C. INTER-SERVICE DYNAMICS: FROM COOPERATION TO COMPETITION

Inter-Service dynamics undeniably contributed to the Navy's establishment of a rigid airship program in 1919. While the War and Navy Departments demonstrated a continuous effort to cooperate as the field of aviation emerged, friction slowly developed during World War I, and then exploded into a fierce three-way competition between the War and Navy Departments, and the followers of General William "Billy" Mitchell in 1919.[59] The battle would go before Congress, and the public, and develop into what Edward Arpee called "the Seven Years' War between the Navy and General Mitchell."[60] Significantly, Mitchell's vision of air power, and a unified air force, included the rigid airship.[61] He would make efforts, regardless of established joint policy and legal constraints, to secure rigid airships for the Army Air Service.[62] Mitchell's "agitation" in

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[57] Althoff, *Sky Ships*, 3.

[58] Robinson and Keller, *"Up Ship!,"* 11.

[59] Alfred F. Hurley, *Billy Mitchell* Crusader for Air Power (Indianapolis: Indiana University Press, 1975); Trimble, *Admiral W. A. Moffett*; Turnbull and Lord, *History of U.S. Naval Aviation*; Thomas Wildenberg, *Billy Mitchell's War with the Navy*: The Interwar Rivalry over Air Power (Annapolis, MD: Naval Institute Press, 2013).

[60] Edward Arpee, *From Frigates to Flat-Tops* (Lake Forest, IL: Edward Arpee, 1953), 91.

[61] William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power* (New York: G. P. Putnam's Sons, 1925), 38–39; Hurley, *Billy Mitchell*.

[62] John Duggan and Henry C. Meyer, *Airships in International Affairs, 1890–1940* (New York: Palgrave Publishers Ltd., 2001), 70–72; Robinson, *Giants in the Sky*, 186–88; Robinson and Keller, *"Up Ship!,"* 116–17.

1919, made it all the more imperative for the Navy to initiate a rigid airship program before Congress could change its mind about which Service had the ultimate responsibility for their development and employment.[63]

At the Departmental level, the Services made efforts to cooperate and establish policy regarding aeronautical activities and development. These cooperative efforts came out in the form of several joint boards beginning in 1916. Realizing the potential of lighter-than-air craft, the War Department requested to establish a Joint Army-Navy Board in 1916 for the purpose of "securing cooperation between the Army and Navy in the development of airships and fixing their respective responsibility."[64] The Board, while it felt that airships would "prove to be a valuable asset" decided to focus more generally on Army and Navy aviation roles and responsibilities in wartime.[65] The Board became the Joint Army and Navy Board on Aeronautic Cognizance and established Service aviation responsibilities, which were as follows:

Army:

- aircraft operating in conjunction with the mobile army;
- aircraft required for fire control for coastal defenses;
- aircraft required for the defense of fortifications, navy yards, arsenals, cities, and shipbuilding plants, powder works, or other similar important utilities, whether public or private, that are located on shore.

Navy:

- aircraft operating in conjunction with the fleets;
- aircraft operating from shore bases for overseas scouting;
- aircraft operating under the commandants of naval districts and advanced bases.[66]

In addition, the Board established the Joint Army-Navy Airship Board which met from 1917–1918 to identify areas for potential cooperation in airship development and

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[63] Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*; Turnbull and Lord, *History of U.S. Naval Aviation*, 176–85.

[64] Turnbull and Lord, *History of U.S. Naval Aviation*, 75.

[65] Ibid., 75–77.

[66] Ibid., 75–76.

employment.[67] The Chief of the Army Signal Corps, LTC George O. Squier, who proposed the board initially, realized the utility of airships and thought it would "make for efficiency and economy of public funds" if the Army and Navy pooled resources to develop these mutually beneficial aircraft.[68] While rigid airships had obvious naval uses, as demonstrated by the German naval zeppelins in the war, they also showed promise in support of the Army's coastal defense mission.[69]

The Joint Army-Navy Airship Board made many significant steps towards setting conditions for a successful rigid airship program in the United States before it dissolved at the end of World War I. The Board worked with the U.S. Bureau of Mines "to build a plant to investigate helium production" in recognition of the United States' abundance of the inflammable lifting gas which made its use much safer than the hydrogen used in every other nation's airships.[70] The Board recommended the mass-production of duralumin, a lighter and stronger aluminum alloy employed in German zeppelins to create the internal superstructure of rigid airships.[71] Additionally, the board established responsibility for rigid airship development and employment. The Airship Board, in an ironic twist considering the War Department initiated it, gave the responsibility for rigid airship development entirely to the Navy.[72] In its final statements to the Service Secretaries in 1918, the board recommended, "in view of the primarily naval use of the rigid airship, the Navy should undertake design and construction, furnishing full information to the Army."[73] This statement was later codified into a fixed policy that, "the development of rigid dirigibles, including the incidental acquisition of dirigibles in foreign countries, be assigned to and carried on exclusively by the Navy and that the Army lend to the Navy any

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67 Althoff, *Sky Ships*, 3; Robinson, *Giants in the Sky*, 184–86; Robinson and Keller, *"Up Ship!,"* 8–10.

68 MAJ Billy Mitchell had been Squier's deputy prior to Mitchell's deployment to Europe in January 1917 as an observer. Hurley, *Billy Mitchell*, 21; Robinson and Keller, *"Up Ship!,"* 9.

69 Althoff, *Sky Ships*, 3; Hurley, *Billy Mitchell;* Robinson and Keller, *"Up Ship!."*

70 Ibid., 279; Robinson, *Giants in the Sky*, 185–86; Robinson and Keller, *"Up Ship!,"* 9.

71 Althoff, *Sky Ships*, 280; Robinson and Keller, *"Up Ship!,"* 9.

72 Robinson and Keller, "*Up Ship!*," 10.

73 Ibid.

personnel particularly qualified in this work."[74] While the War Department and Secretary of War Newton Baker were willing to accommodate the Navy, General Mitchell was not about to give up rigid airships.

General Mitchell returned from World War I ready to fight for his views of air power, which included acquiring airships, and the establishment of an independent air force.[75] In March 1919, the Navy's preeminent aeronautical engineer Jerome Hunsaker, who was returning across the Atlantic on the same ship as Mitchell, warned the Navy that, "[Mitchell] is fully prepared, with evidence, plans, data, propaganda posters and articles, to break things wide open."[76] Mitchell articulated his desire to acquire the rigid airship before Congress, and the public, highlighting the airship's usefulness for "the direct attack of naval vessels at sea and formations of various sorts on land, and in time of peace, for transport of troops and material."[77] Mitchell's belief in the airship went back to 1906, 10 years before he actually became formally associated with aviation.[78] In a published lecture, he noted the airship's great potential for offensive operations and reconnaissance over land and sea.[79] However, Mitchell made the mistake of stating before the House Military Affairs Committee in 1919, that with the proper aerial capabilities, his unified air force could "carry the war to such an extent … as almost to make navies useless on the surface of the water."[80] This, and the fact that he erroneously indicated that the General Board agreed with this assessment, earned him the immediate negative attention of the Navy.[81] Nevertheless, the publicity and the associated congressional debate inflated his public image and enhanced the rivalry.

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74 Turnbull and Lord, *History of U.S. Naval Aviation*, 183.

75 Hurley, *Billy Mitchell*, 39.

76 Ibid., 38; Turnbull and Lord, *History of U.S. Naval Aviation*, 177.

77 Hurley, *Billy Mitchell*, 44.

78 Ibid., 11–12, 21.

79 Ibid., 11–12.

80 Turnbull and Lord, *History of U.S. Naval Aviation*, 178.

81 Ibid., 179.

Meanwhile, in July 1919, Mitchell attempted to acquire a zeppelin from the German Zeppelin Company (*Luftshiffbau-Zeppelin*) despite established policy and the fact that the United States was still technically at war with Germany.[82] COL William N. Hensley, U.S. Army, travelled to Europe ostensibly to "acquire as much information as practicable concerning airships and airship stations in England."[83] However, by the next month, the War Department telegraphed Hensley and instructed him to establish contact, and a contract, with the German Zeppelin Company in an effort to purchase one of their airships, the L-72.[84] Hensley successfully met with representatives of the Zeppelin Company in Switzerland, and established a contract for the purchase of L-72.[85] These activities, however, were fundamentally in violation of the Trading with the Enemy Act and Article 201 of the Versailles treaty, which forbade the company from constructing zeppelins.[86] Mitchell slipped up before Congress, "one thing we have not done is to develop any … rigid airships … and we have attempted very strenuously lately with the help of the War Department to get L-72 which is in Germany."[87] As details of the transaction found their way to Secretary of War Baker, he realized he had been misled. Baker explained to Secretary of the Navy Daniels:

> I permitted negotiations to be entered into … When I became fully acquainted with the facts in the matter and realized that we were entering into negotiations with nationals of a country with which we were still at war … I therefore promptly gave instructions to cancel the contract and to drop the matter entirely.[88]

Mitchell later complained in front of the Senate Committee on Military Affairs that, "we negotiated and … we had almost bought the biggest airship in the world in Germany

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[82] Robinson, *Giants in the Sky*, 186–88; Robinson and Keller, *"Up Ship!,"* 116–118.

[83] Robinson, *Giants in the Sky*, 186–87.

[84] Mitchell, *Winged Defense*, 38–39; Robinson, *Giants in the Sky*, 186–87.

[85] Lehmann and Mingos, *The Zeppelins*, 318–20; Robinson, *Giants in the Sky*, 186–87.

[86] Ibid.

[87] Turnbull and Lord, *History of U.S. Naval Aviation*, 182–83.

[88] Robinson and Keller, *"Up Ship!,"* 118.

at a very small cost."[89] Nevertheless, Mitchell did not give up and eventually secured a contract with the Italian government for the purchase of the ill-fated airship *ROMA*.[90] The Navy, however, had not heard the last of Mitchell and his efforts to secure an airship from the German Zeppelin Company.[91] Rigid airships were an integral part of Mitchell's vision, and while he remained active in the eyes of Congress and the American people, he represented a threat to not only the Navy's rigid airship program, but to naval aviation in general.[92] The Navy had to fulfill its requirements as identified by Congress and the Joint Army-Navy Airship Board; otherwise, the rigid airship could fall into Mitchell's hands in the furtherance of his vision.[93]

D. INTRA-SERVICE DYNAMICS: VISION AND PERSISTENCE

Intra-service dynamics within the Navy Department go further in explaining why the United States Navy chose to initiate a rigid airship program in 1919. Respected senior officers within the Service were aware of the evolving nature of aviation technology, both at home and abroad, and began to develop new "theor[ies] of victory" incorporating this technology.[94] Senior officers, like Admirals George Dewey and Bradley A. Fiske saw the potential of aviation, and the rigid airship, as early as 1910.[95] They encouraged and protected the early naval aviators in an organization that seemed relentlessly determined to resist change.[96] These senior officers supported experimentation and actively utilized intelligence from Europe to enhance their understanding of changes in the geostrategic and

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89 Ibid.

90 John B. Mitchell, *The Army Airship ROMA* (Hampton, VA: Syms-Eaton Museum, 1973), 6; Robinson and Keller, *"Up Ship!,"* 118; Nancy E. Sheppard, *The Airship ROMA Disaster in Hampton Roads* (Charleston: The History Press, 2016), 22.

91 Mitchell, *Winged Defense*, 39; Robinson and Keller, *"Up Ship!,"* 118.

92 Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*; Hurley, *Billy Mitchell*; Mitchell, *Winged Defense*, 38–39.

93 Smith, *The Airships Akron & Macon*, 9–13.

94 Rosen, *Winning the Next War*, 52, 57.

95 Turnbull and Lord, *History of U.S. Naval Aviation*, 8–51.

96 Rosen, *Winning the Next War*, 57–58.

technological landscape.[97] However, the change process was long, subtle, and there were competing theories of victory.[98] Aviators debated whether the future lay in heavier-than-air or lighter-than-air, while at the same time competing with the traditional concepts of offensive sea control.[99] Further complicating matters, the majority of these senior officers sat on the General Board where they had no authority to direct change; all they could do was observe and offer their advice to the Secretary of the Navy.[100] The Chiefs of the Navy's Bureaus, on the other hand, had the authority to direct change and ignore the General Board's recommendations as they fought to maintain "cognizance" over aviation functions that they perceived as part of their domain.[101] Nevertheless, the persistent encouragement of senior officers, and the General Board, sustained naval aviation long enough for it to demonstrate its potential in World War I. More importantly, for this study, they maintained a belief, over decades, in the potential of the rigid airship as a valuable component of the future Fleet. This persistence, and conviction, contributed significantly to the program that began in 1919.

In 1910, Admiral Dewey, the hero of Manila and chairman of the General Board, created an embryonic aviation section within the Navy Department and appointed CAPT Washington Irving Chambers as its head.[102] Dewey's "interests in aeronautics already dated back several years" and this move followed the initial recommendations of RADM William S. Cowles and LT George C. Sweet.[103] Sweet had published a letter in 1908 that left an impression, in which he stated:

> Attention is invited to the great encouragement being given to inventors of like apparatus [i.e., the airplane] abroad, particularly in Germany and France. It is believed that the Department should not be behind in this, as

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97 Ibid., 75.

98 Ibid., 58.

99 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 70–72; Trimble, *Admiral W. A. Moffett*, 7–8.

100 Turnbull and Lord, *History of U.S. Naval Aviation*, 45.

101 Ibid., 10.

102 Ibid., 7–8.

103 Admiral Cowles was also Theodore Roosevelt's brother-in-law. Ibid., 4–5.

> the most practicable flying-machine at present is the invention of a citizen of the United States, and it would seem advisable to lead other navies in this as in the past has been done in other features.[104]

RADM Cowles, the Chief of the Bureau of Equipment, had protected Sweet and encouraged his efforts, but it took Admiral Dewey's recognition of aviation's potential to place CAPT Chambers, an officer of rank, in a position to monitor "all developments" in aviation at home and abroad.[105] While Chambers lacked any authority to implement, he reported to the General Board, and his recommendations encouraged further research and development in aviation as well as "awaken[ed] the general interest of the Navy in flying."[106]

In addition, CAPT Bradley A. Fiske came forward as an ardent supporter of aviation, rigid airships, and related technology. Fiske believed that "command of the air" was "just as important as command of the seas."[107] He persistently advocated for the acquisition of aircraft and placing aircraft on naval vessels.[108] Fiske also saw the potential to use aircraft, as early as 1911, in the defense of the Philippines, a measure that seemed more critical after the Japanese victory over the Russians in the Russo-Japanese war of 1905.[109] By 1912, now a Rear Admiral, Fiske became enthusiastic about the potential for the airplane to carry torpedoes and clearly articulated their role as the "far-sighted eyes for ships."[110] By 1913, Fiske had risen to be the Secretary of the Navy's Aid for Operations, the precursor to the position of Chief of Naval Operations (CNO).[111]

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[104] Ibid., 5.

[105] Ibid., 4–7.

[106] Ibid., 8–9.

[107] Ibid., 48.

[108] Ibid., 9–71.

[109] Ibid., 16.

[110] Ibid., 22.

[111] Ibid., 28.

It was at this time, in 1913, that Fiske articulated a necessity for rigid airships in the Navy.[112] Fiske stated that other nations' rigid airship technology had "reached a state of development that our Navy cannot ignore."[113] Jerome Hunsaker, the Navy's most competent aeronautical engineer, had just returned from Europe examining developments in aviation abroad and his report supported Admiral Fiske's views.[114] Hunsaker reported that, "the principal function of the dirigible in naval warfare is to supplement the work of scout cruisers, and its offensive powers [will] rarely be called upon."[115] On a more disconcerting note, Hunsaker reported that America, the "first nation to fly," was behind in virtually every aspect of aeronautical development.[116] Accordingly, Fiske recommended the General Board closely examine rigid airships and determine their potential utility for aerial reconnaissance and countermine operations while considering the greater issues of developing aviation within the Navy.[117]

The Board, with the assistance of CAPT Chambers, examined the state of German zeppelin development and found that a craft capable of carrying "14,000 pounds, two one-pounder guns and four Maxims, with fuel for 30 hours at the top speed of 45.7 miles per hour" might be a useful adjunct to the fleet.[118] The Board recommended that the Navy Department begin working towards acquiring "the largest class of rigid battle-airships, with sheds and harbors located at strategic points."[119] However, the Bureau of Construction and Repair felt that dirigibles were "too hazardous" and Secretary Daniels disapproved the Board's recommendations to invest in lighter-than-air technology.[120] Chambers pressed on however, with his final report requesting $1,297,300 for 50 airplanes and one "Fleet

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112 Robinson and Keller, *"Up Ship!,"* 7.

113 Ibid.; Turnbull and Lord, *History of U.S. Naval Aviation*, 29.

114 Robinson and Keller, "*Up Ship!*," 8; Turnbull and Lord, *History of U.S. Naval Aviation*, 35.

115 Robinson and Keller, *"Up Ship!,"* 8.

116 Turnbull and Lord, *History of U.S. Naval Aviation*, 35.

117 Ibid., 29.

118 Ibid.

119 Ibid., 30.

120 Robinson and Keller, *"Up Ship!,"* 7.

dirigible."[121] In the end, nothing immediately came of his recommendations and he was forced to retire in 1914 for not having enough time at sea to be eligible for promotion.[122]

Chambers' replacement was CAPT Mark L. Bristol. Admiral Fiske assisted Bristol by pushing for the establishment of an Office of Aeronautics and naming Bristol its "Director."[123] This gave Chambers more weight in his interaction with the Bureaus that, in accordance with Secretary Daniels' General Order No. 41, still retained "cognizance" over aviation related activities within their departments.[124] Bristol aggressively embraced his duties, with Admiral Fiske providing support, as the United States moved closer to war in Europe.[125] Nevertheless, the bureaucratic resistance of the Bureaus and the Secretary were a constant impediment to progress.

Bristol, likely due to Fiske's influence, had an affinity for dirigibles. While Chambers and the handful of other official naval aviators in existence leaned towards heavier-than-air flight, Bristol believed that rigid airships would one day be "Dreadnaughts" of the sky.[126] Others challenged his views making the oft-repeated assertion that airships were too slow and vulnerable to be of any real value.[127] Bristol believed that, like battleships, large rigid airships would need escorts in contested spaces but would still be capable of performing offensive missions in spite of their bulk and speed.[128] In 1915, Bristol managed to secure funds for the Navy's first "A-Class" non-rigid airship, or blimp, but it could barely fly when it was delivered in 1917 and was

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[121] Turnbull and Lord, *History of U.S. Naval Aviation,* 34.

[122] Ibid.

[123] Ibid., 36–37.

[124] Aviation related functions were split between the Bureaus of Construction and Repair, Steam Engineering, and Navigation according to General Order No. 41. This "decentralization" made any coordinated aviation effort in the Navy Department virtually impossible. Ibid., 41.

[125] Ibid., 45.

[126] Bristol could have also been influenced by R.P. Hearne's aerial fleet concept in which the rigid airship assumed the role of "dreadnaught" and the semi-rigid airship took on the role of a "cruiser." Hearne, *Airships in Peace and War: The Second Edition of Aerial Warfare*, 92–109; Turnbull and Lord, *History of U.S. Naval Aviation*, 50.

[127] Turnbull and Lord, *History of U.S. Naval Aviation,* 50.

[128] Ibid.

dismantled "after a few short flights."[129] In the spring of 1917, the Navy eventually secured funds for 16 "B-Class" non-rigid airships that flew 3,600 hours, over 400,000 miles, in anti-submarine operations off the eastern seaboard in World War I.[130] Bristol's most significant contribution, however, was to establish a pre-war lighter-than-air training station near Akron, Ohio in cooperation with the Goodyear Tire & Rubber Company.[131] This began to build a base of loyal and trained lighter-than-air men within the Navy Department's small aviation community.[132] These men would serve in Europe at Paimboeuf, France flying French and Italian non-rigid airships, escorting convoys, and conducting anti-submarine patrols.[133] During World War I, no German U-boat succeeded in sinking any vessel under Allied airship escort.[134]

One of these new lighter-than-air men, LT Lewis H. Maxfield would become the rigid airship's leading advocate after the war.[135] According to Jerome Hunsaker, "It was largely due to [his] enthusiasm and energy that the Department agreed to approve a rigid airship program and the Lakehurst station [in 1919]."[136] However, Maxfield was not alone; he had a number of senior officer supporters including Admiral Henry T. Mayo, CAPT Ernest J. King, and Admiral William S. Sims.[137] After the war, CAPT King told the General Board, "I don't see how … long distance reconnaissance is going to be carried on without using dirigibles … there certainly doesn't seem to be any very great promise in

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129 W.H. Sitz, "Technical Note No. 160: A History of U.S. Naval Aviation," ed. Navy Department (Washington, DC: Bureau of Aeronautics, 1925), 61; Turnbull and Lord, *History of U.S. Naval Aviation*, 50–51, 84–85.

130 This second generation of non-rigid airship came after Bristol's departure in March 1916. Sitz, "Technical Note No. 160: A *History of U.S. Naval Aviation*," 10, 61–62.

131 Litchfield, *Autumn Leaves*, 175–78; Robinson and Keller, *"Up Ship!,"* 8; Turnbull and Lord, *History of U.S. Naval Aviation*, 50–51; J. Gordon Vaeth, *Blimps & U-Boats: U.S. Navy Airships in the Battle of the Atlantic* (Annapolis, MD: Naval Institute Press, 1992), 1–12.

132 Turnbull and Lord, *History of U.S. Naval Aviation*, 50–51.

133 Ibid., 132–36; Sitz, "Technical Note No. 160: A History of U.S. Naval Aviation," 26–27.

134 Litchfield, *Autumn Leaves*, 178; Vaeth, *Blimps & U-Boats*, 1–2.

135 Robinson and Keller, *"Up Ship!,"* 11; Turnbull and Lord, *History of U.S. Naval Aviation*, 67.

136 Robinson, *Giants in the Sky*, 188; Robinson and Keller, *"Up Ship!,"* 11.

137 Smith, *The Airships Akron & Macon*, xxi.

airplanes for long-distance scouting."[138] Admiral Sims stated, "The future rigid airships will be part of the fleet of every first-rate naval power. Delay of one year now in the development of this art will serve to keep the United States in an unfavorable position in comparison with those of other great powers for some years."[139] In 1919, the General Board acknowledged, and recommended that despite post-war austerity measures:

> Rigid airships are a necessity for supplementing long distance scouting for the Fleet. A fleet without rigid airships is at a most serious disadvantage as compared to one with rigid airships. Rigid airships should be established [in the United States] as an industry … The government should undertake the construction and development of rigid airships.[140]

Congress listened and was willing to give the Navy and its rigid airships a chance with the appropriation of 1919. Over a decade and a half of persistence seemed to have finally paid off. However, the "generational change" required to make the rigid airship a permanent part of the Fleet was far from over, and the program would face turbulent intra-service dynamics for the remainder of its existence.[141]

E. SOCIO-CULTURAL DYNAMICS: COMPETITION, EMULATION, AND PRESTIGE

The U.S. Navy's decision to adopt rigid airships was also driven by a cultural desire to enhance its prestige and legitimacy through emulating the military models of other respected naval powers like Great Britain.[142] The credit for the creation of the rigid-type airship obviously goes to Germany. Yet, despite the German zeppelin's lackluster performance in World War I, the majority of the great powers were still eager to pursue rigid airship technology, whether for military or commercial purposes.[143] This process is best described by sociology's New Institutionalism and the concept of institutional

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[138] Ibid.

[139] Ibid.

[140] Ibid.

[141] Rosen, *Winning the Next War*, 80, 109.

[142] Goldman, "Spread of Western Military Models."; Robinson and Keller, *"Up Ship!,"* 195.

[143] Duggan and Meyer, *Airships in International Affairs, 1890–1940*; Robinson, *Giants in the Sky*.

isomorphism.[144] New Institutionalism accepts that organizations will emulate the successful practices, and technologies, of other organizations out of a sense of competition for survival.[145] However, as in the instance of the U.S. Navy's decision to initiate a rigid airship program, New Institutionalism also asserts that, in the face of uncertainty, the social desire to attain prestige or legitimacy equally motivates organizations to emulate one another.[146] It is certain the U.S. Navy faced multiple competitors, and an array of rapidly emerging technologies, in the geostrategic landscape following World War I. The Navy, accordingly, chose the rigid airship not only for its military potential but also due to a perception that the rigid-type airship had become a norm among great powers.[147] This represents an example of institutional isomorphism in which the Navy intended to emulate, and adopt, other great powers' technologies "in the absence of evidence that [this technology would] increase internal organizational efficiency."[148] The rigid airship appears to have appealed to the U.S. Navy as an "accessible" and "prestigious" model for emulation despite a lack of concrete evidence of its future benefits to Fleet.[149]

The technological and mechanical strength of the American Navy had been associated with power and prestige since the writings of A.T. Mahan and the beginning of the 20th century.[150] Furthermore, the navies of the world's other "great powers" demonstrated a remarkable example of isomorphism through their universal adoption of Mahan's offensive sea-control doctrine, which equated fleet strength to national power.[151] As George Baer notes, "similarity of doctrine and of force structure among the major navies of the world meant that superiority could be defined as a function of naval construction."[152]

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144 Goldman, "Spread of Western Military Models," 41, 43–44.

145 Ibid., 43.

146 Ibid.

147 Farrell and Terriff, "Sources of Military Change," 7–9.

148 Goldman, "Spread of Western Military Models," 43.

149 Ibid., 44.

150 Baer, *One Hundred Years of Sea Power*, 9–26; Zakaria, *From Wealth to Power*, 126.

151 Baer, *One Hundred Years of Sea Power*, 9–26.

152 Ibid., 84.

Technological prowess offered potential advantages in combat as well as national prestige.[153] President Taft noted in 1912, "I believe that it is essential … that we should preserve our prestige, by the exhibition of actual power."[154] Power, according to the General Board, was "measured by the number and efficiency of heavy fighting units, or battleships."[155] With the majority of major industrialized nations in agreement, naval technology rapidly proliferated among the great powers as they sought perpetually to emulate one another in their efforts to secure or maintain international prestige and legitimacy.[156] H.G. Wells captured this sentiment juxtaposed with the potential of airships in his work *The War in the Air* (1908):

> So it was that Bert Smallways saw the first fight of the airship and the final fight of those strangest things in the whole history of war: the ironclad battleships … the world produced over twelve thousand five hundred of these strange monsters, in schools, in types, in series, each larger and heavier and more deadly than its predecessors. Each in its turn was hailed as the last birth of time, most in their turn were sold for old iron. Only about five per cent of them ever fought in a battle. Some foundered, some went ashore and broke up, several rammed one another by accident and sank … Money had to be found for them at any cost—that was the law of a nation's existence during that strange time. Surely they were the weirdest, most destructive and wasteful megatheria in the whole history of mechanical invention.
>
> And then cheap things of gas and basket-work made an end of them altogether, smiting out of the sky![157]

As Wells, and the majority of the world apparently realized, the rigid airship represented a potential paradigm shift. Slowly, in the years leading up to 1919, the United States Navy realized this as well. More disconcertingly, the Navy realized that it was very far behind the other "progressive" nations of the world that were "bent on keeping abreast

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153 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 1–18.

154 Meyer, "Annual Reports of the Navy Department (1912)," 19.

155 Josephus Daniels, "Annual Report of the Secretary of the Navy (1914)," ed. Navy Department (Washington, DC: Government Printing Office, 1914), 53.

156 Baer, *One Hundred Years of Sea Power*, 39.

157 H.G. Wells, *The War in the Air* (London: George Bell and Sons, 1908), 167–68.

of the times."[158] The primary manner in which the Navy advocated for aviation capabilities and rigid airships was by comparing the United States' "deplorable" aeronautical condition to other potential competitors.[159] For example, the 1913 Report of the Secretary of the Navy stated:

> The value of air craft in warfare has been so highly regarded in most European countries that the war and naval budgets embrace many million dollars for experiment work, construction, and operation for every type of airship. In this country, while American aviators were the first to demonstrate the success of aviation, the fruits of discovery have not been as fully utilized by us as they have been abroad … The best scientific and military judgment of the world is that no nation can be said to be fully prepared for war that neglects this new military weapon of offense and defense.[160]

The Navy Department showed a growing realization that the airplane and airship represented a new international norm.[161] By the end of World War I, it was clear to senior leaders that the United States had not only entered the war unprepared, but the Navy risked losing power and prestige if it did not take action to rectify its technological shortcomings. In the face of uncertainty, the rigid airship appeared to be a technology worth emulating. According to the General Board in 1919, German zeppelins were, "so remarkable that it is most necessary for the Navy of the United States to develop dirigibles of this type as soon as possible."[162] The situation grew desperate, however, when the American Congress refused to ratify the Versailles Treaty and the United States was denied an opportunity to acquire a highly prized German zeppelin as a war indemnity.[163] Worse, the remaining German zeppelins went to the other great powers: Great Britain, France, Italy, Belgium, and Japan.[164] In 1919, Admiral Sims stated, "the future rigid airships will be part of the

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158 Meyer, "Annual Reports of the Navy Department (1912)," 156.

159 Daniels, "Annual Report of the Secretary of the Navy (1914)," 59.

160 "Annual Reports of the Navy Department for the Fiscal Year 1913," ed. Navy Department (Washington, DC: Government Printing Office, 1914), 17.

161 Farrell and Terriff, "Sources of Military Change," 7–9.

162 Smith, *The Airships Akron & Macon*, xx.

163 Robinson and Keller, *"Up Ship!,"* 3.

164 Robinson, *Giants in the Sky*, 142; Robinson and Keller, *"Up Ship!,"* 3.

fleet of every first-rate naval power."[165] If the United States wanted rigid airships in order to be a first-rate naval power, it would have to find another way to procure them. Retaining prestige and legitimacy within the international system appears to have contributed as much as strategic competition did to the Navy Department's decision to initiate a rigid airship program in 1919.[166]

Ultimately, the combination of geopolitical competition and the social pressure to emulate other powers encouraged the U.S. Navy to pursue rigid airship technology in the face of an ambiguous post-war environment.[167] Being the only power without rigid airships would be a military disadvantage and a demonstration of American technological ineptitude. This possibility became glaringly clear in July 1919 when the British rigid airship R-34 completed the first round-trip transatlantic flight and visited Long Island, New York.[168] While the Navy's NC-4 flying boat had made it across the Atlantic six weeks earlier, the trip was one-way, making multiple stops, and required the support of 68 destroyers and five battleships.[169] The flight of the NC-4 was hailed as an important milestone. However, the R-34's arrival, and successful return to England, clearly demonstrated a better way and "made the rigid airship a reality for millions of Americans."[170] It is unsurprising that after the R34's success the Navy Department and Congress took active measures to ensure that America would not be left behind in the development of rigid airships.[171] Significantly, and in further evidence of the Navy's uncertainty and emulation, at the same time the Department began its rigid airship program it also decided to convert a fleet collier into its first aircraft carrier, a wartime invention of

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165 Smith, *The Airships Akron & Macon*, xxi.

166 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 3, 5–6; Goldman, "Spread of Western Military Models," 44.

167 Goldman, "Spread of Western Military Models," 44–45.

168 Interestingly, COL Hensley secured a ride on the R-34 on its return trip to Europe in his failed attempt to purchase a zeppelin from the German Zeppelin Company. Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 11; Robinson, *Giants in the Sky*, 186; Robinson and Keller, *"Up Ship!,"* 12.

169 Turnbull and Lord, *History of U.S. Naval Aviation*, 164–67.

170 Robinson and Keller, *"Up Ship!,"* 12.

171 Arpee, *From Frigates to Flat-Tops*, 191; Robinson and Keller, *"Up Ship!,"* 12.

the British.[172] As the General Board observed in 1919, the further development of naval aviation was essential if the United States wanted to achieve "its proper place as a Naval power" in the post-war world.[173]

F. SYNTHESIS AND CONCLUSION

In summary, evidence strongly indicates that despite grinding bureaucratic resistance, the Navy Department ultimately initiated its rigid airship program in 1919 through a combination of intra-service, inter-service, and socio-cultural dynamics. Civil-military dynamics, specifically civilian intervention, did occur, but did not apparently play an instrumental role in influencing the decision. Ultimately, the U.S. Navy had to convince economizing civilian leaders of the requirement for rigid airships. Furthermore, the civilian interventions that occurred from 1900–1919 in favor of aviation were more exploratory, hesitant, and lacked the conviction required to overcome the internal bureaucratic resistance of the Navy's Bureaus.

The Navy's perceived requirement for rigid airships derived from an enduring theory of naval aviation among senior officers, and a growing cadre of junior officers, that envisioned the rigid airship as an essential component of the future Fleet.[174] Furthermore, the Navy could not risk losing its embryonic aviation capabilities, or the rigid airship, to the aggressive machinations of General Mitchell or an independent air force.[175] Lastly, when faced with an uncertain future, and a multitude of emerging technologies of undetermined potential, the Navy opted to reduce uncertainty by emulating other great powers in its adoption of the rigid airship, and notably, the aircraft carrier.[176] The Navy's decision to initiate a rigid airship program came, fundamentally, from the dynamic

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[172] Robinson and Keller, *"Up Ship!,"* xii; Geoffrey Till, "Adopting the Aircraft Carrier: The British, American, and Japanese Case Studies," in *Military Innovation in the Interwar Period*, ed. Williamson Murray and Allan R. Millett (New York: Cambridge University Press, 1998), 194–95; Turnbull and Lord, *History of U.S. Naval Aviation*, 153–55, 62.

[173] Turnbull and Lord, *History of U.S. Naval Aviation*, 161.

[174] Ibid.

[175] Duggan and Meyer, *Airships in International Affairs, 1890–1940*; Robinson and Keller, "*Up Ship!*"; Turnbull and Lord, *History of U.S. Naval Aviation*.

[176] Goldman, "Spread of Western Military Models," 43.

interaction of these external and internal pressures and the desire to retain legitimacy and prestige in a new world order.[177]

The question remains, however, why did the U.S. Navy continue to pursue rigid airships in the years ahead when the technology failed to live up to its expected potential? Were the same forces that started the program as influential in sustaining innovation or did they transform into barriers? What forces ultimately terminated the program? The following chapters seek to answer these questions.

[177] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 5–6; Goldman, "Spread of Western Military Models."

III. EXPERIMENTATION, DEVELOPMENT, AND SETBACKS (1920–1928)

> I know that lighter-than-air has gone through a pretty tough record and many lives have been lost … This is the Navy's job. That is what we are paid for. That is what we take chances for. This is why we are ready to give up our lives if necessary, in the development of new arms, and for that reason … I have always felt that, within reasonable limits, that should not deter us from going ahead with the job we have got to do.
>
> —Admiral William V. Pratt
> Chief of Naval Operations (1931-33)[1]

A. INTRODUCTION

The purpose of this chapter is to determine which factors contributed to the sustainment and, most critically, to the continuation of the U.S. Navy's rigid airship program beyond the "LTA Crisis of 1925–1926."[2] From 1920 to 1928 the U.S. Navy launched its rigid airship program with the airships ZR-1 (*Shenandoah*), ZR-2 (R38), and ZR-3 (*Los Angeles*). However, by 1925, the program was in an "unsettled state" after the American-built *Shenandoah* crashed killing 14 crewmembers.[3] This tragedy added on to the previous loss of the British-built ZR-2 (R38) in England, which the U.S. Navy had ordered in accordance with the Naval Appropriation Act of 1919.[4] In August 1921, the R38 suffered structural failure and exploded on its fourth flight resulting in the deaths of 44 British and American aviators.[5] In short, both of the rigid airships Congress had

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[1] Arpee does not specify at which point in the rigid airship program's development Admiral Pratt made this comment, but it captures the organizational culture of the Navy Department discussed in more detail in the section on socio-cultural dynamics. Arpee, *From Frigates to Flat-Tops*, 233.

[2] Lighter-than-air (LTA). Smith, *The Airships Akron & Macon*, 9–13.

[3] William A. Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1926)," ed. Department of the Navy (Washington, DC: Government Printing Office, 1926), 18, 41.

[4] Robinson, *Giants in the Sky*, 186; Sitz, "Technical Note No. 160: A *History of U.S. Naval Aviation*," 65–66; Turnbull and Lord, *History of U.S. Naval Aviation*, 172–73.

[5] CDR L.H. Maxfield was among the American dead. Robinson, *Giants in the Sky*, 171–73, 88; Sitz, "Technical Note No. 160: A History of U.S. Naval Aviation," 65–66; Turnbull and Lord, *History of U.S. Naval Aviation*, 173.

authorized in 1919 were destroyed with the loss of 30 American aviators and over $3,500,000 million by 1925.[6] Only the ZR-3 (*Los Angeles*) remained in the Navy's inventory and she was restricted by international agreement from participating in any militarily useful activities until 1931.[7] Accordingly, the situation after the *Shenandoah* crash "necessitated a reconsideration of policy with regard to large airships."[8] However, despite the apparently easy decision of program termination, the Navy Department and Congress ultimately chose to continue the Navy's rigid airship program for over a decade after the loss of the *Shenandoah*. This chapter seeks to answer why and how the U.S. Navy continued the program despite its failures and lack of demonstrated potential from 1920–1928.

Evidence indicates that a combination of civil-military, inter-service, and socio-cultural factors sustained the rigid airship program through the 1920s, and led to the persistence of rigid-type airships in the U.S. Navy into the 1930s. However, in contrast to the program's incipient phase (1900–1919), intra-service dynamics began to form resistance towards the development of rigid airships. The greatest emerging opponents to the rigids seemed to be coming from within the Navy Department and the Bureau of Aeronautics (BuAer) in the heavier-than-air aviators and supporters of carrier aviation.[9] According to Trimble, RADM William A. Moffett, the first Chief of BuAer from 1921–1933, "saw the rigid airship as only one component of a complex, powerful naval air force."[10] However, a growing faction of heavier-than-air advocates would begin to question Moffett's judgment.[11] Nevertheless, from 1920–1928 the rigid airship had

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[6] *Shenandoah* (14 killed) and ZR-2 (R38) (16 of 44 killed were U.S. Navy personnel). Robinson, *Giants in the Sky*, 330–43; Robinson and Keller, "*Up Ship!,"* 204–05.

[7] The *Los Angeles*' use was restricted to "civil purposes," at Great Britain's insistence, as a part of the U.S. Department of State's negotiations with the Council of Ambassadors in 1921 to procure her from the German Zeppelin Company. The Allies lifted the restriction in 1931. Robinson, *Giants in the Sky*, 207–21.

[8] Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1926)," 41.

[9] Arpee, *From Frigates to Flat-Tops*, 232; Duggan and Meyer, *Airships in International Affairs, 1890–1940*; Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*; Trimble, *Admiral W. A. Moffett*.

[10] Trimble, *Admiral W. A. Moffett*, 274.

[11] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 92; Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*; Trimble, *Admiral W. A. Moffett*.

powerful allies in the private sector and the executive branch who regularly intervened, directly and indirectly, in furthering the program.[12] In addition, the budding inter-service rivalry of 1919–1920 turned into a war for public and congressional support in the resource-constrained environment of the 1920s.[13] Accordingly, the Navy Department was willing to unify against the common threat of General William "Billy" Mitchell, and his independent air force advocates, to preserve the Navy's sovereignty over its aviation and, in particular, its rigid airships.[14] Lastly, the cultural norms and values of the U.S. Navy, Congress, and American society interacted to shape the development of rigid airship technology and to overcome the tragic failures of the ZR-1 and ZR-2.[15]

This chapter examines the period from 1920–1928 continuing within the four core paradigms of military innovation studies: civil-military;[16] inter-service;[17] intra-service;[18] and socio-cultural.[19] The chapter begins in 1920, as the Navy's rigid airship program began to take form, and concludes in 1928 when the U.S. Congress ultimately appropriated the funds for the next generation of rigid airships, the aerial aircraft carriers ZRS-4 (*Akron*) and ZRS-5 (*Macon*).[20] This chapter examines: 1) the civil-military dynamics in the form of the civilian interventions that influenced the rigid airship program; 2) the related inter-service dynamics, namely the competition between the Navy and War Departments and Mitchell's faction of independent air force advocates; 3) the growing divisions within the

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12 Arpee, *From Frigates to Flat-Tops*; Lehmann and Mingos, *The Zeppelins*; Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*.

13 Vincent Davis, *The Admirals Lobby* (Chapel Hill: The University of North Carolina Press, 1967), 73–100; Hurley, *Billy Mitchell*; Trimble, *Admiral W. A. Moffett*, 141–66; Wildenberg, *Billy Mitchell's War with the Navy*.

14 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 81–103; Hurley, *Billy Mitchell*; Robinson and Keller, "*Up Ship!*"; Turnbull and Lord, *History of U.S. Naval Aviation*, 186–92.

15 A simplified application of the Social Construction of Technology (SCOT). Grissom, "The Future of Military Innovation Studies," 926–27; Pinch and Bijker, "Social Construction of Facts and Artifacts," 21–33.

16 Posen, *Sources of Military Doctrine*.

17 Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*.

18 Rosen, *Winning the Next War*.

19 Adamsky, *Culture of Military Innovation*; Farrell and Terriff, "Sources of Military Change"; Grissom, "The Future of Military Innovation Studies."

20 Rosendahl, *Up Ship!*, 99–101; Smith, *The Airships Akron & Macon*, 17.

Navy over resources and concepts that began to shift increasing numbers of officers against the rigid airship; and 4) the socio-cultural forces that shaped the rigid airship's development and helped sustain it into the 1930s. This period of development and experimentation, hampered as it was by disastrous setbacks, ultimately resulted in the continuation of the rigid airship program into the late 1930s. Why and how this occurred is the focus of the chapter.

B. CIVIL-MILITARY DYNAMICS: COMMERCIAL AND EXECUTIVE INTERVENTION

Empirical evidence strongly indicates that civil-military dynamics, specifically in the form of civilian intervention, played a decisive role in contributing to the continuation of the U.S. Navy's rigid airship program at multiple points from 1920–1928. In the 1920s, America shifted from a policy of international engagement under President Woodrow Wilson to prioritizing economy, efficiency, and strategic isolation.[21] By 1920, the American people and the Senate had rejected the Versailles Treaty, the League of Nations, and the policies of President Wilson.[22] In November 1920, America gave the Republican Party victory by electing Warren G. Harding President, with 60.2% of the popular vote, and giving the Republicans controlling majorities in the United States Congress.[23] Under President Harding (1921–1923), the United States would turn towards "normalcy" and away from exorbitant military spending and the chaos that war and demobilization had brought to the county.[24] According to Harding, "Our supreme task is the resumption of our onward, normal way."[25] The policies of Harding, and his successor, Calvin Coolidge (1923–1929), would remain fixed on fiscal conservatism, commercial stimulus, and efficiency in government.[26] As aviation grew in importance, Harding and Coolidge would

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[21] Robert H. Ferrell, *The Presidency of Calvin Coolidge*, ed. Donald R. McCoy, Clifford S. Griffin, and Homer E. Socolofsky, American Presidency Series (Lawrence: University Press of Kansas, 1998); Trani and Wilson, *Warren G. Harding*.

[22] Baer, *One Hundred Years of Sea Power*, 93; Trani and Wilson, Warren G. Harding.

[23] Warren G. Harding, 28.

[24] Hurley, *Billy Mitchell*, 41–42; Trani and Wilson, *Warren G. Harding*, 1–29.

[25] Trani and Wilson, *Warren G. Harding*, 54.

[26] Ferrell, *Calvin Coolidge*; Trani and Wilson, *Warren G. Harding*.

demonstrate an active interest, and involvement, in its progress and potential.[27] The rigid airship, and aviation in general, presented unique opportunities for the United States, American politicians, and businessmen in terms of profit and military efficiency. As a result, the period of rigid airship development from 1920–1928 saw several key civilian interventions that interacted and contributed to the growth and continuation of the program despite its repeated failures. This section specifically examines the interactions and key interventions of Presidents Harding and Coolidge that occurred during the rigid airship program's first eight years.

President Harding contributed to the furtherance of rigid airship development in the United States both directly and indirectly. Harding's key interventions included: 1) directing U.S. Congress to establish a Bureau of Aeronautics in the Navy Department;[28] 2) establishing the Bureau of Budget to oversee and control government spending;[29] 3) inviting the world's great naval powers to the Washington Conference with the aim to reduce naval expenditures and achieve stability through diplomacy;[30] and 4) making procurement of a rigid airship from the German Zeppelin Company a Presidentially-directed priority.[31] The aggregation of these interventions created an environment where military and civilian decision-makers continuously sought effectiveness and efficiency under severe fiscal constraints and international arms limitation agreements.[32] Without Harding's interventions that set favorable conditions for naval aviation and the rigid airship, it is unclear whether the airship program would have survived beyond the early 1920s.

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[27] Arpee, *From Frigates to Flat-Tops*; Hurley, *Billy Mitchell*; Smith, *The Airships Akron & Macon*; Wildenberg, *Billy Mitchell's War with the Navy*.

[28] Davis, *The Admirals Lobby*; Trimble, *Admiral W. A. Moffett*; Turnbull and Lord, *History of U.S. Naval Aviation*.

[29] Davis, *The Admirals Lobby*.

[30] Baer, *One Hundred Years of Sea Power*; Roger Dingman, *Power in the Pacific: Origins of Naval Arms Limitation, 1914–1922* (Chicago: University of Chicago Press, 1976); Sprout, *Toward a New Order of Sea Power*.

[31] Arpee, *From Frigates to Flat-Tops*; Duggan and Meyer, *Airships in International Affairs, 1890–1940*; Lehmann and Mingos, *The Zeppelins*; Robinson and Keller, "*Up Ship!*".

[32] John T. Kuehn, *Agents of Innovation: The General Board and the Design of the Fleet That Defeated the Japanese* (Annapolis, MD: Naval Institute Press, 2008).

First, Harding directed Congress to establish a Bureau of Aeronautics (BuAer) in the U.S. Navy largely in response to the political and military division created by General Billy Mitchell's efforts to create an independent air force.[33] In April 1921, one month after Harding's inauguration, the President summoned a special Joint Session of Congress and stated, "Aviation is inseparable from either the Army or the Navy … and I recommend the establishment of a Bureau of Aeronautics in the Navy Department to centralize control of naval activities in aeronautics."[34] The Republican Congress accepted Harding's recommendation and established BuAer in law on July 12, 1921.[35] This recommendation largely came at the request of the Navy Department, which realized that its disjointed and *ad hoc* approach to naval aviation only served to validate General Mitchell's efficiency arguments for an independent air force.[36] While significant, the creation of BuAer also inflamed the inter-service competition over resources for military aviation, and rigid airships, which would continue into the 1930s.[37] The inter-service rivalry between Mitchell and BuAer, and its impact on the rigid airship program, is addressed in more detail in the next section on inter-service dynamics.

Second, Harding sought to reduce government spending through the establishment of the Bureau of Budget on June 10, 1921.[38] The Budget and Accounting Act established the Bureau of Budget and budget officers in the military services that reported directly to the President.[39] The Bureau of Budget existed solely to ensure departmental spending remained "in line with administration policies."[40] Furthermore, potentially in response to

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[33] Davis, *The Admirals Lobby*; Duggan and Meyer, *Airships in International Affairs, 1890–1940*; Turnbull and Lord, *History of U.S. Naval Aviation.*

[34] Turnbull and Lord, *History of U.S. Naval Aviation*, 188; Wildenberg, *Billy Mitchell's War with the Navy*, 62.

[35] Turnbull and Lord, *History of U.S. Naval Aviation*, 189–90.

[36] Davis, *The Admirals Lobby*, 79–81; Trimble, *Admiral W. A. Moffett*, 65–66; Turnbull and Lord, *History of U.S. Naval Aviation*.

[37] Arpee, *From Frigates to Flat-Tops*; Hurley, *Billy Mitchell*; Smith, *The Airships Akron & Macon*; Trimble, *Admiral W. A. Moffett*; Wildenberg, *Billy Mitchell's War with the Navy*.

[38] Also established the General Accounting Office. Trani and Wilson, *Warren G. Harding*, 61–62.

[39] Davis, *The Admirals Lobby*, 80; Trani and Wilson, *Warren G. Harding*, 62.

[40] Turnbull and Lord, *History of U.S. Naval Aviation*, 225.

Mitchell's lobbying of Congress, the Budget Act specified that "no estimate or request for an appropriation and no request for an increase … shall be submitted to Congress or any committee thereof by any officer … of any department … [except] at request of either House."[41] The Budget Act effectively prevented the Navy, and BuAer, from approaching Congress with recommendations or justifications for increased funds unless being specifically summoned.[42] To make matters worse, an anti-aviation officer, RADM Joseph Strauss, assumed the Navy Department's budget officer functions.[43] As a result, BuAer would find its annual budget estimates cut an average of 46%, or by $14.6 million, from 1923–1928 by RADM Strauss, the Bureau of Budget, and Congress.[44] BuAer, accordingly, had to find a balance between being frugal and innovative in the years ahead. The rigid airship, with its dramatically cheaper unit cost, higher speed, and larger scouting radius than the scouting cruisers it could potentially replace, provided a tempting alternative to the Navy.[45] For BuAer, and Admiral Moffett, the rigid airship also presented a unique publicity tool to draw attention, and funding, to naval aviation.[46]

Third, the Washington Conference (1921–1922), called at the invitation of President Harding, turned the temptation of the rigid airship into an apparent necessity.[47] President Harding's ultimate aim, according to George Baer, "was to reduce the threat of war, not prepare to win one."[48] The anti-military sentiment of the American people and Congress made the naval expansion required to defend American interests in the Far East untenable.[49] Harding's Secretary of State, Charles Evans Hughes, felt that the naval

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41 Ibid., 226.

42 Ibid.

43 Davis, *The Admirals Lobby*, 80; Turnbull and Lord, *History of U.S. Naval Aviation*, 226.

44 Trimble, *Admiral W. A. Moffett*, 278–79.

45 Smith, *The Airships Akron & Macon*, 9, 13.

46 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 75; Trimble, *Admiral W. A. Moffett*; Robinson and Keller, "*Up Ship!*".

47 Trimble, *Admiral W. A. Moffett*; Smith, *The Airships Akron & Macon*; Robinson and Keller, "*Up Ship!*."

48 Baer, *One Hundred Years of Sea Power*, 93.

49 Ibid., 93–94; Sprout, *Toward a New Order of Sea Power*, 104–21.

building program initiated under President Wilson in 1916 would not survive under the new Republican Congress.[50] Furthermore, if naval expansion continued it could lead to an unwinnable naval arms race with Great Britain and Japan.[51] Japan's acquisition of Germany's former Pacific possessions in 1919, and the fact that these "mandates" sat along the lines of communication from the United States to the Philippines and China, added additional impetus towards some form of diplomatic settlement.[52] The existing Anglo-Japanese Alliance, set to expire in July of 1921, further complicated matters.[53] Nevertheless, President Harding delayed until "the drive of public opinion" could no longer be ignored.[54]

On July 8, 1921 President Harding invited the world's great powers to attend the Washington Conference to discuss "limitation of armament" and "[to reach] a common understanding with respect to principles and policies in the Far East."[55] The Conference resulted in three treaties that limited naval armaments and preserved the status quo, and the Open Door, in the Pacific.[56] The Five Power Treaty suspended capital ship construction for 10 years and established tonnage ratios for the battleships of United States, Great Britain, Japan, France, and Italy (5:5:3:1.67:1.67).[57] Auxiliary vessels would be reduced in proportion to capital ships.[58] Carriers were limited to 27,000 tons and all powers agreed to maintain the "status quo" by not increasing the fortification of their existing Pacific

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[50] Baer, *One Hundred Years of Sea Power*, 94; Charles E. Hughes, *The Autobiographical Notes of Charles Evans Hughes*, ed. David J. Danelski and Joseph S. Tulchin, Studies in Legal History (Cambridge: Harvard University Press, 1973), 239–40.

[51] Baer, *One Hundred Years of Sea Power*, 94; Hughes, *The Autobiographical Notes of Charles Evans Hughes*, 239.

[52] Hughes, *The Autobiographical Notes of Charles Evans Hughes*, 230–36.

[53] Sprout, *Toward a New Order of Sea Power*, 133.

[54] Hughes, *The Autobiographical Notes of Charles Evans Hughes*, 240.

[55] Sprout, *Toward a New Order of Sea Power*, 135.

[56] Richard W. Fanning, *Peace and Disarmament: Naval Rivalry and Arms Control 1922–1933* (Lexington: The University Press of Kentucky, 1995), 6–7; Sprout, *Toward a New Order of Sea Power*, 302–17.

[57] Fanning, *Peace and Disarmament*, 6–7.

[58] Ibid.

possessions or establishing new bases.[59] Importantly, the treaties placed no restrictions on military aviation or rigid airships.[60] As the Navy reevaluated its war plan against Japan, War Plan ORANGE, its seaplanes, aircraft carriers, and rigid airships became important platforms that could fill capabilities gaps, and meet the scouting requirements of the fleet's battle-line in the immense spaces of the Pacific Ocean.[61] Aircraft carriers, two of which the Navy converted from cruisers banned by the Washington Conference, and rigid airships would compete to meet these requirements.[62]

Fourth, President Harding took a direct role in helping the United States procure the ZR-3 (*Los Angeles*) from Germany. American businessmen were eager to exploit the potential of the rigid airship in the early 1920s.[63] Among them, former Assistant Secretary of the Navy Franklin D. Roosevelt started the American Investigation Corporation (AIC) in 1921 to establish a rigid airship passenger service in the United States.[64] Working with Johann Shütte, a German airship designer and competitor of the Zeppelin Company, Roosevelt and the AIC anticipated being capable of transporting one hundred passengers per flight across the United States or the Atlantic Ocean.[65] Roosevelt was enthusiastic: "Wait until my dirigibles are running, and then you will be able to take a form of transportation that is absolutely safe."[66] However, Roosevelt's future as "an aviation

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[59] Article XIX of the Five Power Treaty was the infamous non-fortification clause. The Aleutian and Hawaiian Islands were excluded from the agreement. Ibid.; Sprout, *Toward a New Order of Sea Power*, 304–05.

[60] Hurley, *Billy Mitchell*, 70–71; Trimble, *Admiral W. A. Moffett*, 91–97.

[61] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 92; Edward S. Miller, *War Plan Orange: The U.S. Strategy to Defeat Japan 1897–1945* (Annapolis, MD: Naval Institute Press, 1991), 176–77; Robinson and Keller, "*Up Ship!*," xi-xii; Smith, *The Airships Akron & Macon*, xx-xxi.

[62] The *Saratoga* and the *Lexington*. Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 92; Robinson and Keller, "*Up Ship!*," xi-xii; Turnbull and Lord, *History of U.S. Naval Aviation*, 209–10.

[63] German airshipmen were also eager to exploit American businessmen. Duggan and Meyer, *Airships in International Affairs, 1890–1940*; Litchfield, *Industrial Voyage*; Meyer, *Airshipmen Businessmen and Politics*.

[64] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 78–79.

[65] Meyer, *Airshipmen Businessmen and Politics*, 66–74.

[66] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 79; Meyer, *Airshipmen Businessmen and Politics*, 66.

business tycoon" ended when AIC went into default in 1923.[67] Roosevelt appealed to Harry Vissering, a rigid airship entrepreneur from Chicago, for assistance but Vissering refused.[68]

Vissering, a longtime friend of President Harding, had been interested in starting a rigid airship industry and transportation service in the United States since 1919.[69] His contact with Ernst Lehmann of the Zeppelin Company, as early as 1919, began a productive relationship for the Germans.[70] As a result of the Versailles Treaty, the German zeppelins were to be handed over to the Allies and the German airship industry was to be dismantled.[71] The Zeppelin Company, namely its Chairman Hugo Eckener and his associate Lehmann, sought to establish a link with American industry in order to save the company.[72] They found that link in Vissering, who became their official American representative by 1922.[73] Vissering's connection with the Zeppelin Company is likely the reason he refused to assist Roosevelt, who was partnered with a Zeppelin competitor.[74] Vissering, importantly, connected Goodyear Tire & Rubber Company's P.W. Litchfield and Zeppelin's Eckener, leading to the formation of the Goodyear-Zeppelin partnership in

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67 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 79; Meyer, *Airshipmen Businessmen and Politics*, 73–74.

68 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 94; Meyer, *Airshipmen Businessmen and Politics*, 71–72.

69 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 14, 78; Robinson and Keller, *"Up Ship!,"* 119–20.

70 Lehmann and Mingos, *The Zeppelins*, 321–22.

71 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 81–82; Lehmann and Mingos, *The Zeppelins*, 306–18; Meyer, *Airshipmen Businessmen and Politics*, 141; Robinson and Keller, "*Up Ship!*," 119–21.

72 Zeppelin's managing director Alfred Colsman was actually first to America where he made initial contact with "Goodyear, Ford, the U.S. Navy, and a financial group in New York." Litchfield, *Industrial Voyage*, 236–39; Meyer, *Airshipmen Businessmen and Politics*, 63–66.

73 Vissering also published the book *Zeppelin: The Story of a Great Achievement* in 1922 advertising the Zeppelin Company and the potential for commercial rigid airship operations in the United States. Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 81; Vissering, *Zeppelin*, 53–59.

74 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 78.

1923.[75] As President 10 years later, Franklin D. Roosevelt maintained his animosity towards anything "Zeppelin" and referred to Goodyear as "that rubber company."[76]

Vissering also influenced his friend Harding towards linking the U.S. government with the Germans in in an attempt to secure a state-of-the-art zeppelin.[77] According to Secretary of State Hughes, "President Harding was a most kindly man, always eager to please his old friends and to make new ones. He found it difficult to say no."[78] In 1921, Vissering convinced President Harding to acquire a rigid airship from the Zeppelin Company, and thereby delay the company's imminent dismantling.[79] According to Lehmann's account:

> [Vissering] decided to call upon President Harding. The two had been friends for years, and Mr. Harding had become a convert to the cause of lighter-than-air. When Vissering put his case before the Chief Executive in the summer of 1921, it was not on the plea of personal friendship but of national expediency. President Harding immediately agreed to press the American claims for a Zeppelin.[80]

Harding directed Secretary Hughes to negotiate an agreement with the Allies via the Council of Ambassadors in Paris.[81] The Allies initially resisted, largely because they were all attempting to further their own fledgling rigid airship programs.[82] However, in December 1921, the State Department secured approval for the U.S. Government to acquire

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[75] P.W. Litchfield makes no mention of Vissering in his autobiography while the standard airship historians and members of the Zeppelin Co. do. Ibid., 94; Lehmann and Mingos, *The Zeppelins*, 327–28; Litchfield, *Industrial Voyage*, 237–39; Meyer, *Airshipmen Businessmen and Politics*, 71.

[76] Arpee, *From Frigates to Flat-Tops*, 191; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 94; Meyer, *Airshipmen Businessmen and Politics*, 241.

[77] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 81–83.

[78] Hughes, *The Autobiographical Notes of Charles Evans Hughes*, 199.

[79] Litchfield writes that the U.S. Government asked him, as the representative of a private civilian commercial interest, to engage the Zeppelin Co. directly as a means to bypass the international negotiations in order to secure the German zeppelin patent rights. Litchfield, *Industrial Voyage*, 237–39; Robinson and Keller, *"Up Ship!,"* 120.

[80] Lehmann and Mingos, *The Zeppelins*, 325.

[81] Ibid.; Robinson and Keller, *"Up Ship!,"* 120.

[82] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 96; Lehmann and Mingos, *The Zeppelins*, 325.

one rigid airship from the Zeppelin Company on the condition that the vessel was "devoted to purely civil purposes."[83] In accordance with previous national policy regarding rigid airship development, and reconfirmed by the Joint Army-Navy Board of 1921, the responsibility for "the construction, acceptance, and maintenance" of this new German airship would fall on the U.S. Navy.[84] This airship, completed in 1924, would become the ZR-3, *Los Angeles*, which would be the longest serving, and arguably, most successful of the U.S. Navy's rigid-type airships.[85]

Lastly, Calvin Coolidge assumed the Presidency after Harding's unexpected death in 1923. Coolidge was "taciturn and noncommittal" as well as "[dedicated] to rigid economy."[86] He once reportedly challenged the War Department's budget request with, "Who's gonna fight us?"[87] According to Robert Ferrell, "[Coolidge] was especially concerned about the navy, whose admirals were always thinking about constructing more ships."[88] Nevertheless, Coolidge did display an increasing interest in aviation.[89] He approved a polar expedition for the *Shenandoah* in November 1923, saying, "it is eminently fitting that the Navy should continue this work, and I believe that the expedition … will be of great practical value."[90] Coolidge later cancelled the expedition in February 1924 when Congressional scrutiny over the Tea Pot Dome scandal increased, and he felt that failure of the polar flight would reflect badly on him personally.[91] In October 1924, Coolidge was present when his wife christened the *Los Angeles*.[92] In 1927, the President provided Charles Lindbergh accommodations with the first family upon his return to the United

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[83] Robinson and Keller, *"Up Ship!,"* 121–22.

[84] Althoff, *Los Angeles*, 7; Robinson and Keller, *"Up Ship!,"* 121.

[85] Althoff, *Los Angeles*, xxiii; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 100.

[86] Hughes, *The Autobiographical Notes of Charles Evans Hughes*, 200; Hurley, *Billy Mitchell*, 85.

[87] Wildenberg, *Billy Mitchell's War with the Navy*, 117.

[88] Ferrell, *Calvin Coolidge*, 26.

[89] Ibid., 26–27; Hurley, *Billy Mitchell*.

[90] Althoff, *Sky Ships*, 32; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 95–96; Robinson and Keller, *"Up Ship!,"* 77–78.

[91] Robinson and Keller, "*Up Ship!*," 79, 89.

[92] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 101.

States after his successful transatlantic flight.[93] However, Coolidge's interest in aviation translated into his greatest intervention in the form of the Morrow Board.

Coolidge created the Morrow Board, headed by his friend Dwight Morrow, to investigate the state of aviation within the United States.[94] The proximate triggers for Coolidge's intervention in aviation policy in September 1925 were: 1) the crash of the *Shenandoah* and disappearance of a flight of Navy flying boats en route to Hawaii in September 1925;[95] and 2) Billy Mitchell's subsequent public accusations that the Navy and War Departments were responsible for the "incompetency, criminal negligence, and almost treasonable administration of the national defense."[96] However, Coolidge had been planning to launch the Morrow Board for months prior to the precipitating events.[97] According to William Trimble, "[the] economic distress of the aviation industry and the likelihood that the Mitchell imbroglio would cause irreparable damage to the military services convinced [Coolidge] that he had to do something."[98] The Morrow Board provided the first full-scale review and establishment of aviation policy in the United States of America.[99] Notably the Board determined that Billy Mitchell's allegations were unfounded and that creation of his independent air force was not advisable.[100]

Additionally, the Board concurred with Admiral Moffett, the Chief of BuAer, that the Navy and aviation industry needed long-range building programs. Moffett used the Board's findings, approved by President Coolidge in December 1925, to gain legislative approval for H.R. 9690, which authorized a Five Year Aircraft Program that would add 1,000 planes to the U.S. Navy by 1931.[101] In addition, H.R. 9690 authorized $8,000,000

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93 Ferrell, *Calvin Coolidge*, 35.

94 Hurley, *Billy Mitchell*, 99.

95 Ibid., 100; Trimble, *Admiral W. A. Moffett*, 157–162.

96 Hurley, *Billy Mitchell*, 101.

97 Ibid., 99.

98 Trimble, *Admiral W. A. Moffett*, 162.

99 Ibid., 167; Turnbull and Lord, *History of U.S. Naval Aviation*, 209.

100 Trimble, *Admiral W. A. Moffett*, 165.

101 Smith, *The Airships Akron & Macon*, 13; Trimble, *Admiral W. A. Moffett*, 177.

for the construction of Moffett's "fleet-type airships," the aerial aircraft carriers ZRS-4 (*Akron*) and ZRS-5 (*Macon*).[102] The first design competition for these fleet airships occurred in 1927 with Goodyear-Zeppelin being the only realistic bidder.[103] Nevertheless, gaining the appropriations for these final airships required additional civilian intervention from both Goodyear-Zeppelin and President Coolidge. In the end, it was an appeal from Goodyear-Zeppelin's sales manager that prompted Coolidge on March 19, 1928 to instruct the House Committee on Naval Affairs to appropriate the funds for two fleet-type airships for the U.S. Navy.[104]

In summary, civil-military dynamics and intervention were much more influential from 1920–1928 than they had been in the 19 preceding years. Civilian decision makers, and businessmen, intervened and set conditions ensuring the program continued beyond the "LTA crises of 1925–1926" after the *Shenandoah*, and the earlier ZR-2, crashes had killed 30 American naval aviators.[105] Yet, there were more dynamics at play. The role of Billy Mitchell, as already intimated, and his desire to use rigid airships in the furtherance of his independent air force agenda, also played a decisive role in the Navy's decision to continue the program into the 1930s.[106]

C. INTER-SERVICE DYNAMICS: THE AIR POWER WAR

Inter-service dynamics, in the form of the rivalry between the U.S. Navy, the War Department, and General Billy Mitchell, played a critical role in keeping the U.S. Navy's rigid airship program alive beyond its logical termination point in 1925. From 1919–1925, General Mitchell, as the Assistant Chief of the Army Air Service, and the U.S. Navy engaged in what Edward Arpee referred to as "the Seven Years' War" over the future of

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[102] Smith, *The Airships Akron & Macon*, 13; Trimble, *Admiral W. A. Moffett*, 177.

[103] Goodyear-Zeppelin was the only entity to bid on the contract with the actual capacity to construct the airship(s) and fulfill the contract requirements. Smith, *The Airships Akron & Macon*, 15.

[104] Ibid., 16–17.

[105] 14 died on the *Shenandoah* (1925) and 16 Americans died on the R38 (ZR2) (1921). Robinson and Keller, *"Up Ship!,"* 109; Smith, *The Airships Akron & Macon*, 3.

[106] Smith, *The Airships Akron & Macon*, 13.

air power in the United States military establishment.[107] Mitchell lobbied Congress and the public from 1919–1920 for an independent air force that would centralize all military aviation under one department, and remove it from the Navy and War Departments.[108] Mitchell believed that aviation had rendered previous methods of warfare obsolete and he specifically targeted, literally and figuratively, the battleship.[109] In the end, Mitchell's extreme publicity methods, and the competition they engendered, drove the U.S. Navy and Admiral Moffett to fight to retain the rigid airship to prevent it from falling into Mitchell's hands.[110]

In 1920, Mitchell continued to undermine the Navy's aviation efforts and sought ways to acquire rigid airships for the U.S. Army. Secretary of War Newton D. Baker, likely at Mitchell's insistence, attempted to negotiate a revision of previous Joint Army-Navy policy that gave the Navy sole responsibility for rigid airship development.[111] The Joint Army-Navy Board of 1921, however, reconfirmed the Navy's primacy in rigid airship development.[112] Next, Mitchell worked through Congressional friends to manipulate the National Defense Act of 1920. Mitchell sought to "[secure] a rider … turning all naval air stations over to the Army and restricting the Navy to 'aerial operations attached to a fleet.'"[113] The Navy caught on to Mitchell's plan to "[prevent] the Navy from operating any large land-based aircraft" which would include rigid airships.[114] While not completely successful, Mitchell and his allies in Congress were successful in limiting the Navy to six shore stations, a 50% cut from the Navy's wartime high.[115] However, Mitchell's political

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[107] Arpee, *From Frigates to Flat-Tops*, 91.

[108] Hurley, *Billy Mitchell*, 39–55.

[109] Ibid.; Trimble, *Admiral W. A. Moffett*; Wildenberg, *Billy Mitchell's War with the Navy*.

[110] Smith, *The Airships Akron & Macon*, 9–13; Trimble, *Admiral W. A. Moffett*.

[111] Hurley, *Billy Mitchell*, 49.

[112] Ibid.; Smith, *The Airships Akron & Macon*, 13.

[113] Trimble, *Admiral W. A. Moffett*, 72.

[114] Ibid.

[115] A.M. Pride, *United States Naval Aviation in Review 1911–1951*, ed. Department of the Navy Bureau of Aeronautics (Washington, DC: U.S. Government Printing Office, 1951), 4; Trimble, *Admiral W. A. Moffett*, 72.

maneuvers had the significant unintended consequence of leading to the establishment of BuAer, and the appointment of his nemesis Admiral William A. Moffett as its Chief, on July 26, 1921.[116]

Mitchell turned towards sensationalism and spectacle as a means of gaining public and Congressional support. At the Joint Army-Navy Bombing Trials from June to July of 1921, Mitchell had joined, and then ruined, the trials by violating exercise protocols in order to "sink [a] battleship in as spectacular a fashion as possible."[117] While the Navy intended the trials to be deliberate and scientific, Mitchell did not intend to miss a chance to sink a battleship in support of his widely publicized claims.[118] These trials, and the resultant sinking of the German battleship *Ostfriesland*, fueled intense public and political debate about the future role of airpower and the continued relevance of the surface navy.[119] They also contributed to popular sentiment favoring naval arms limitation in the coming months at the Washington Conference.[120] Mitchell added to these publicity victories through sending his bombers in mock raids against New York City, Philadelphia, and the U.S. Naval Academy to demonstrate the vulnerability of the United States to aerial attack.[121] The Navy, and Admiral Moffett, attempted to use Mitchell's "propaganda" to gain additional funding for naval aviation and aircraft carriers without any results.[122]

As part of this struggle, Mitchell and the U.S. Army made deliberate efforts to acquire rigid airships, a critical component of Mitchell's vision for American airpower. Mitchell continued his assertions from 1919 that the rigid airship could best function in support of the U.S. Army's, or an independent air force's, coastal defense mission.[123]

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116 Davis, *The Admirals Lobby*, 78–79; Hurley, *Billy Mitchell*, 61; Trimble, *Admiral W. A. Moffett*, 80; Turnbull and Lord, *History of U.S. Naval Aviation*, 186–90.

117 Hurley's words, not Mitchell's. Hurley, *Billy Mitchell*, 67.

118 Ibid., 64–65.

119 Ibid., 68.

120 Fanning, *Peace and Disarmament*, 4; Wildenberg, *Billy Mitchell's War with the Navy*, 86.

121 Hurley, *Billy Mitchell*, 68; Wildenberg, *Billy Mitchell's War with the Navy*, 83–84.

122 Wildenberg, *Billy Mitchell's War with the Navy*, 84–85.

123 Mitchell also claimed that aircraft carriers needed to belong to his envisioned independent air force. Hurley, *Billy Mitchell*, 43–44.

Primarily, Mitchell believed that the U.S. Army Air Service's responsibilities should extend as far as the range of its land-based aircraft.[124] Accordingly, a rigid airship that could fly 3,000 miles out to sea would be very beneficial in expanding the scope of the Air Service's missions and funding.[125] In support of this goal, Mitchell supported Army experimentation in December 1924 in "landing … an airplane on an airship" with the aim of creating dirigible "airplane carrier[s]."[126] Fundamentally, Mitchell believed that the rigid airship could perform critical reconnaissance and nighttime heavy-bombing functions in a layered coastal defense plan that would "render surface craft incapable of operating to the same extent that they have … if it does not entirely drive them off the surface of the water."[127] The War Department seemed to concur as evidenced by the results of its Lassiter Board (1923–1924) that recommended the U.S. Army operate 20 airships in peacetime, expanding to 31 airships in wartime.[128] The Board also recommended that: 1) the Army operate up to 200 miles from the coast; and 2) that the services combine aviation appropriations with 60% going to the Army and 40% to the Navy.[129] The Navy refused to accept the recommendations.[130]

Ultimately, Mitchell and the War Department's behavior created perceptions within the Navy Department and BuAer that the U.S. Army wanted to take over the Navy's mandate for rigid airship development. After the Air Service's Italian semi-rigid airship *ROMA* crashed in February 1922, killing 34 Army aviators, Mitchell increased his efforts

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[124] Ibid., 43.

[125] The patrol radius of the *Macon* was 3,078 statute miles. Ibid; Smith, *The Airships Akron & Macon*, 13, 207.

[126] The apparatus the Army developed would later be handed over to the Navy Department and turned into the "sky-hook" employed on the airships *Akron* and *Macon*. Hurley, *Billy Mitchell*, 80; Mitchell, *Winged Defense*, 92–93; Smith, *The Airships Akron & Macon*.

[127] Mitchell's plan was very similar to the concept Wellman proposed in 1911. Hurley, *Billy Mitchell*, 59; Wellman, *The Aerial Age*, 444–445.

[128] Hurley, *Billy Mitchell*, 84–85.

[129] Ibid., 85, 91; Wildenberg, *Billy Mitchell's War with the Navy*, 112–17.

[130] Wildenberg, *Billy Mitchell's War with the Navy*, 117.

to acquire a rigid airship.[131] The ZR-3 (*Los Angeles*), under construction in Germany from November 1922 to October 1924, became the obvious target.[132] According to Duggan and Meyer, "General Mitchell's episodic pressure to wrest the new German airship from the Navy" enhanced the Navy's defensiveness and paranoia.[133] General Mitchell's actions led Moffett to state that "they [i.e., the Army] control 50% of helium and will withhold their half" to gain advantage and take over the *Los Angeles*.[134] Admiral Moffett felt that Mitchell's desires to seize the ZR-3 went as far back as the Washington Conference:

> In 1922, at the Limitations of Arms Conference I set [Mitchell] back on his heels. He tried to take over the chairmanship of the session on aviation, and the first subject on the agenda was reparations. This country was scheduled to get one of the latest German Zeppelins, converted to a merchantman, and I didn't intend to let the Army beat me to that punch. When Mitchell breezed in with a secretary, all ready to take the chair, I inquired by what authority he pretended to assume the chairmanship. He mumbled something about rank. 'Since when,' I demanded 'does a one-star Brigadier rate a two-star Admiral?' That stopped him, and the Navy got the *Los Angeles*.[135]

LCDR Garland Fulton, supervising the construction of the ZR-3 in Germany, had the following to say with regard to inter-service collaboration on the project:

> I do not believe that we should make any compromises with our [Army] friends in regard to final disposition of ZR3 … I feel it is a Navy job and if we take a strong stand the [Army] hasn't a leg to stand on. We must take a strong stand or they will knife us in the back.[136]

Despite their efforts, the War Department, and Mitchell, failed to acquire the ZR-3 or any other rigid airship.[137] Meanwhile, Moffett used his airships to maximum advantage in his publicity war with Mitchell.

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131 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 90; Mitchell, *The Army Airship ROMA*; Sheppard, *ROMA Disaster*.

132 Althoff, *Los Angeles*, 9–33.

133 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 97.

134 Althoff, *Los Angeles*, 20–21.

135 Arpee, *From Frigates to Flat-Tops*, 104–05.

136 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 98.

137 Robinson and Keller, *"Up Ship!,"* 10, 222.

Moffett's successful utilization of the *Shenandoah* and *Los Angeles* for publicity purposes grew in response to Mitchell's sensationalism from 1923–1925. *Shenandoah* made her first flight in September 1923, one day after the Army Air Service destroyed the battleships *New Jersey* and *Virginia* in another series of controversial bombing trials.[138] Moffett, and the Navy Department's senior leaders, would send the *Shenandoah* on an increasing number of publicity, or "hand-waving," flights from 1923–1925.[139] *Shenandoah* would be present at air races, state fairs, aviation demonstrations and would become a source of political influence that the Navy Department utilized to gain the support of prominent Congressmen and their constituencies.[140] Accordingly, the *Shenandoah* never conducted trial flights and spent little time with the fleet during her brief time with the Navy.[141] According to airship historians, "only 13 of 59 flights recorded in [*Shenandoah*'s] logbook were directly related to her avowed purpose of service with the fleet."[142] Even the airship's transcontinental flight in 1924 was in response to the Army's "World Flight," a circumnavigation of the globe by Army flyers the same year.[143]

In September 1925, when the *Shenandoah* crashed over Ohio, the airship was scheduled to fly over 44 cities in the Midwest corresponding with local fairs and other miscellaneous festivities.[144] Despite the concerns of *Shenandoah*'s commanding officer, CDR Zachary Lansdowne, the Chief of Naval Operations (CNO) Admiral Edward W. Eberle pushed the flight ahead.[145] Eberle noted in his orders to Lansdowne, "this route will

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138 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 95; Wildenberg, *Billy Mitchell's War with the Navy*, 112–15.

139 Robinson and Keller, *"Up Ship!,"* 71.

140 Ibid., 71–72; Trimble, *Admiral W. A. Moffett;* Wildenberg, *Billy Mitchell's War with the Navy*, 135.

141 Robinson and Keller, *"Up Ship!,"* 71.

142 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 95; Robinson and Keller, "*Up Ship!*," 71.

143 Lowell Thomas, *The First World Flight* (New York: Houghton Mifflin Company, 1925); Trimble, *Admiral W. A. Moffett*, 131–32; Wildenberg, *Billy Mitchell's War with the Navy*, 134–35.

144 *Shenandoah's* itinerary lists 44 cities over three legs between Lakehurst to Minneapolis, Minneapolis to St Louis, and from St Louis back to Lakehurst. Robinson and Keller, *"Up Ship!,"* 203; Wildenberg, *Billy Mitchell's War with the Navy*, 135.

145 Robinson and Keller, *"Up Ship!,"* 104.

be published in the press and … many will be disappointed should the *Shenandoah* fail to follow the approved schedule."[146] On 3 September, *Shenandoah* broke apart in a thunderstorm and crashed killing 14 crewmembers including CDR Lansdowne.[147] General Mitchell, as discussed in the previous section, used the opportunity to make his final public push for an independent air service resulting in his December court-martial "for insubordination and conduct unbecoming an officer."[148]

The *Shenandoah* crash led the Navy to reassess its rigid airship program and the military utility of the airship from 1925 to 1926. In the end, a "political feature" played a decisive role in the Navy's decision to continue the program.[149] Fundamentally, the Navy Department did not want to abandon the rigid airship because of the perception that, as airship historian Richard Smith wrote, "the Army was standing by to grab it up."[150] As the future CNO, CAPT William H. Standley, said at the time, "I don't think we want to be placed in this position."[151] The senior naval leadership concurred that if the Army secured rigid airships, the Navy could lose its claim to shore bases, long-range seaplanes, and potentially have its carrier program undermined.[152] None of these alternatives was worth the risk.

The risk perception was undoubtedly furthered in 1926 by the Chief of the Army Air Service, Major General Mason Patrick, when he demanded before the Joint-Army Navy Aeronautical Board that the Board grant "Army aircraft assigned to coast defense … [the] free[dom] to fly over water to the limit of their practical operating radius."[153] While Patrick was likely thinking more of heavy bombers than rigid airships, Admiral Moffett

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146 Ibid.

147 Ibid., 109.

148 Ibid., 110; Rosendahl, *Up Ship!*, 84–85; Wildenberg, *Billy Mitchell's War with the Navy*, 140.

149 Smith, *The Airships Akron & Macon*, 13.

150 Ibid.

151 Ibid.

152 Ibid.

153 Thomas H. Greer, *The Development of Air Doctrine in the Army Air Arm 1917–1941* (Washington, DC: Office of Air Force History, United States Air Force, 1985), 88.

resisted.[154] The Board's final findings did not grant the Army the permission Patrick desired and left "the door open for [the Navy's] air operations."[155] Subsequently, the rigid airship program received a second chance with the fleet airships of the 1930s, the ZRS-4 (*Akron*) and ZRS-5 (*Macon*).[156] The continuation of the program was, ultimately, not so much because of a widespread belief in their military utility, but because of an enduring belief among senior naval officers that the Army still posed a threat to the Navy, and naval aviation, despite Mitchell's downfall.[157]

D. INTRA-SERVICE DYNAMICS: COMPETING VISIONS

The intra-service dynamics within the Navy Department from 1920–1928 were more of an impediment to the rigid airship program than a source of progress. First, while Admiral Moffett began his long-term change process to make naval aviation an essential part of the U.S. Navy, his tendency to use the rigid airships for publicity purposes failed to demonstrate their military usefulness and gain supporters.[158] Next, the continuous expansion of heavier-than-air personnel in the Navy, thanks to Moffett's efforts, also slowly contributed unintentionally to increasing resistance against the rigid airship program.[159] Both of these conditions arose from the resource-scarcity that defined the Navy during Moffett's tenure. As Victor Davis notes about the inter-war Navy, "the diminished appropriations virtually compelled the naval officers … to turn on each other like a pack of starving animals."[160] As Chief of BuAer, Moffett had to balance the development of heavier-than-air and lighter-than-air, and friction between the two camps was inevitable.[161] In comparison to the success of heavier-than-air from 1920–1928, the

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[154] Ibid.

[155] Ibid.

[156] Smith, *The Airships Akron & Macon*, 13–18.

[157] Ibid., 13.

[158] Robinson and Keller, *"Up Ship!,"* 194; Trimble, *Admiral W. A. Moffett*.

[159] Duggan and Meyer, *Airships in International Affairs, 1890–1940*.

[160] Davis, *The Admirals Lobby*, 74.

[161] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 70, 73–74; Smith, *The Airships Akron & Macon*, 9.

rigid airships failed to prove their utility to skeptics within the Navy.[162] Faced with severe resource constraints in terms of personnel and funding, some in BuAer and the Navy began to see the program as parasitic.[163] Nevertheless, the rigid airship maintained the support of the Chief of BuAer, Admiral Moffett. In the end, it seems to have been Moffett's continuous defense of the rigid airships, and belief that the next models would be better, that kept the program alive within the Navy after the *Shenandoah* crisis of 1925–1926.[164]

BuAer's creation did not represent a general admission that the Navy had accepted aviation so much as it represented an institutional reaction against the threat of Billy Mitchell.[165] Moffett, and BuAer, still had to build the legitimacy of naval aviation, and the rigid airship, without threatening the core interests of the battleship-centric Navy Department.[166] Moffett, accordingly, initiated his long-term campaign to establish aviation in the Navy by demonstrating its value through war games and exercises[167] and making aviation "an integral, organic part of the fleet."[168] By FY 1929, aircraft were assigned to the Asiatic, Battle, and Scouting Fleets and flew 64,308 sorties, for 70,574 hours, in support of fleet operations.[169] In contrast, the fleet's exposure to rigid airships was almost nonexistent despite the fact that the rigids had helped bolster publicity for the Navy and naval aviation for six years.[170]

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[162] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 91–92; Robinson and Keller, "*Up Ship!*," 194.

[163] Robinson and Keller, "*Up Ship!*," 139; Smith, *The Airships Akron & Macon*, 9; Trimble, *Admiral W. A. Moffett*, 131.

[164] Rosendahl, *Up Ship*; Trimble, *Admiral W. A. Moffett*; Turnbull and Lord, *History of U.S. Naval Aviation*.

[165] Davis, *The Admirals Lobby*, 78–79.

[166] Ibid., 77; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 73–74; Rosen, *Winning the Next War*, 76–105.

[167] Rosen, *Winning the Next War*, 64–75.

[168] Trimble, *Admiral W. A. Moffett*, 4.

[169] William A. Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1929)," ed. Department of the Navy (Washington, DC: Government Printing Office, 1929), 8.

[170] The *Los Angeles* flew 36 sorties totaling 640.40 hours during the same year. Ibid.; Trimble, *Admiral W. A. Moffett*, 133.

While Moffett was able to leverage exercises and war games to demonstrate the effectiveness of heavier-than-air naval aviation, he was not able to do the same with rigid airships from 1920–1928.[171] Ultimately, the Navy's recognition of the airship's greater potential as a publicity tool than as a weapon essentially stagnated the airship's development for almost a decade.[172] Meanwhile, the aircraft carriers came to be accepted by the Fleet, first with the *Langley* in 1922, and then the *Saratoga* and *Lexington* in 1927.[173] While the carriers participated and exercised with the Fleet regularly, the rigid airships did not.[174] The *Shenandoah*'s construction was already behind schedule in 1922 when the appropriation ran out and Admiral Moffett had to appeal to the Chief of Naval Operations, Admiral Robert E. Coontz, for more funds:[175]

> To fail now to complete the ZR 1 will dissipate the organization of skilled technical personnel which has been built up and allow much of the material which has been assembled to deteriorate. Not only the money spent directly on ZR 1 herself, but this entire outlay of seventeen million will become a loss instead of an asset to the United States, if the rigid airship art is permitted to die in this country … THE COMPLETION OF ZR 1 IS AN ECONOMIC NECESSITY.[176]

While Moffett secured the funding to complete the *Shenandoah*, there were only two years between 1923–1927 that the Navy had an operational airship that was permitted by international agreement to participate in fleet exercises.[177] The *Shenandoah*, out of a combination of pressures from senior leaders in the Navy Department, political officials, and the existential threat of Billy Mitchell, spent the majority of her time dedicated to publicity flights.[178] A note from the 1925 Report of the Bureau of Aeronautics summarizes Moffett's publicity dilemma:

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171 Robinson and Keller, *"Up Ship!,"* 194; Rosen, *Winning the Next War*, 69–75.

172 Robinson and Keller, *"Up Ship!"*

173 Ibid., 194; Trimble, *Admiral W. A. Moffett*, 12.

174 Robinson and Keller, *"Up Ship!,"* 194.

175 Ibid., 58.

176 Capitalization as written in the original source. Ibid.

177 Ibid., 99.

178 Ibid., xii, 114, 194.

> No record of airship operation can be considered complete without mentioning the special interest which exists throughout the country in airships. Many requests are daily received for the *Shenandoah* or *Los Angeles* to visit this or that section of the country. It has been impossible to satisfy all such requests and still carry on with the regularly programmed work of training and operation.[179]

As far as military usefulness, the *Shenandoah* demonstrated relatively little. From 1923–1925 the *Shenandoah* participated in only two scouting exercises with elements of the Fleet.[180] A large amount of *Shenandoah*'s additional flight time, outside of publicity work, was dedicated to mooring exercises with the Fleet airship tender *Patoka*.[181] These experiments were important in determining the viability of operating rigid airships as part of the Fleet for extended periods at sea without access to shore stations.[182] However, these experiments were apparently not as useful to the Navy as the *Shenandoah*'s publicity value.

After the *Shenandoah*'s crash, the Navy had only the *Los Angeles* for experimentation and training from 1925–1931. However, the terms of the Council of Ambassadors that approved her sale to the United States restricted *Los Angeles* from participating in any militarily useful activities like fleet exercises.[183] BuAer considered using her "on a schedule over a regular route" to determine the rigid airship's commercial transportation value.[184] In the end, *Los Angeles* took over the *Shenandoah*'s publicity, experimental, and training missions.[185] Of note, the *Los Angeles* did conduct valuable experiments with the "sky-hook" apparatus, which allowed rigid airships to launch and recover aircraft, and paved the way for its implementation on the fleet airships *Akron* and *Macon*.[186] The tests were so impressive that CNO Eberle dictated in 1926 that any new

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[179] William A. Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1925)," ed. Department of the Navy (Washington, DC: Government Printing Office, 1925), 25.

[180] Robinson and Keller, *"Up Ship!,"* 89, 102.

[181] Ibid., 86–88.

[182] Ibid.

[183] Ibid., 168.

[184] Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1925)," 24.

[185] Althoff, *Los Angeles*; Robinson and Keller, *"Up Ship!,"* 163–76.

[186] Arpee, *From Frigates to Flat-Tops*, 203–05; Robinson and Keller, *"Up Ship!,"* 163–66.

airships had to have the capability to launch and recover aircraft while in flight.[187] However, it was not until 1931 that the Department of State was able to secure approval for the *Los Angeles* to participate in military exercises.[188] In sum, from 1925–1931 the U.S. Navy's only rigid airship, *Los Angeles*, was unable to validate her role as the eyes of the fleet and, unsurprisingly, there were a growing number of officers in the Navy Department and BuAer that viewed the rigid airship as superfluous or unfit for naval operations.[189] In the six-year interim, the Navy's aircraft carriers and heavier-than-air aviators continued to gain experience, acceptance, and demonstrated their utility in operations with the Fleet.[190]

Moffett's process of "generational change," that husbanded naval aviation from 1921–1933, also engendered competition and animosity between lighter-than-air officers and heavier-than-air officers.[191] According to Robinson and Keller, in the early years of the rigid airship program "lighter-than-air men were more senior; flying their magnificent dirigibles, they could not help feeling patronizing toward the early aviators, reckless kids wearing ensign's bars."[192] CAPT Ernest J. King, as Assistant Chief of BuAer, noted that Admiral Moffett had "some special pet people," especially "[in] lighter-than-air."[193] However, Moffett's successful efforts to build a support base for naval aviation personnel created vastly larger numbers of individuals that were loyal to heavier-than-air than lighter-than-air over time.[194] By 1926, BuAer had refined training methods at Pensacola to generate 140 heavier-than-air aviators per year and established the naval observer rating as

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187 Robinson and Keller, "*Up Ship!*," 164.

188 Arpee, *From Frigates to Flat-Tops*, 205–07; Robinson and Keller, *"Up Ship!,"* 168.

189 Robinson and Keller, *"Up Ship!,"* 114–15, 39.

190 Trimble, *Admiral W. A. Moffett*, 200–29; Turnbull and Lord, *History of U.S. Naval Aviation*, 194.

191 Rosen, *Winning the Next War*, 80.

192 Robinson and Keller, *"Up Ship!,"* 8.

193 Arpee, *From Frigates to Flat-Tops*, 147; Trimble, *Admiral W. A. Moffett*, 214–15.

194 Arpee, *From Frigates to Flat-Tops*, 232; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 70; Rosen, *Winning the Next War*, 77.

a mechanism for converting senior officers who were too old to fly.[195] In contrast, lighter-than-air training at Lakehurst only "partially" trained 10 officers for airship operations the same year.[196] These numbers illustrate just how severe an impact the loss of 16 personnel in the ZR-2 crash in 1921, and then 14 on the *Shenandoah* in 1925, must have had on the lighter-than-air community and the prospects of the rigid airship program.[197] In the end, accidents, low force generation, and personnel turnover led to fewer advocates for the rigid airship, as the proponents of aircraft carriers and heavier-than-air aviation proliferated throughout the Navy and "gained in rank and influence."[198] Moffett's successful efforts to build naval aviation as a whole were unintentionally undermining the rigid airship program from within.

In summary, Moffett's utilization of the rigid airships for publicity purposes and the fundamental divergence between heavier-than-air and lighter-than-air personnel began to inadvertently delegitimize the program throughout the 1920s. While Moffett was successful in building a support base for naval aviation over time, the numbers of lighter-than-air personnel remained a small minority in the Navy Department's bureaucracy.[199] In addition, the rigid airships failed to demonstrate any real military value to the fleet from 1923–1928 due to their utilization primarily in generating publicity for the resource-starved Navy Department.[200] Large percentages of their most experienced personnel died in the crashes of ZR-1 and ZR-2 or left to perform mandatory sea duty.[201] Conversely, by 1928, the numbers of heavier-than-air naval aviators were steadily growing and proliferating. More importantly, the Navy's three aircraft carriers had arrived and were beginning to

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195 Arpee, *From Frigates to Flat-Tops*, 232; Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1926)," 19–20; Rosen, *Winning the Next War*, 77; Trimble, *Admiral W. A. Moffett*, 137–38.

196 Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1926)," 19–20.

197 Robinson and Keller, *"Up Ship!,"* 15, 22, 109; Smith, *The Airships Akron & Macon*, 3.

198 Robinson and Keller, *"Up Ship!,"* 8; Rosen, *Winning the Next War*, 79–80; Trimble, *Admiral W. A. Moffett*, 133–36.

199 Arpee, *From Frigates to Flat-Tops*, 232.

200 Robinson and Keller, *"Up Ship!,"* 194.

201 Smith, *The Airships Akron & Macon*, 3.

demonstrate their effectiveness in fleet exercises.[202] As a result, increasing numbers of leaders within the Navy and BuAer began to view Admiral Moffett's enduring support for the rigid airship "as a defect in judgment … while they saw the aircraft carrier with its attack group of aircraft as the decisive aerial weapon at sea."[203] Advocates of the rigid airship, like Admiral Moffett, had to rest their hopes on the fleet airships, *Akron* and *Macon*, without any indication they would be successful or accepted by the fleet.

E. SOCIO-CULTURAL DYNAMICS: HELIUM, SAFETY, AND PERSEVERANCE

Socio-cultural dynamics shaped and sustained the rigid airship program in a variety of ways from 1920–1928. First, American society's reaction to the rigid airship, and rigid airship accidents, shaped the way that the U.S. Navy, and the U.S. government, utilized and developed the technology. This becomes abundantly clear with a brief examination of the Navy's decision to use helium as a lifting gas rather than hydrogen.[204] Next, the strategic and organizational cultures of the United States and the Navy Department, respectively, influenced leaders' reactions to the early failures of the rigid airship program. In short, leaders did not see early failures as program-ending failures, but rather as sacrifices in a critical national effort that necessitated program continuation.[205] Both examples deal with perceptions of safety, loss, and sacrifice and help explain how, in the end, the rigid airship program continued into the 1930s. The following examples are supportive of the Social Construction of Technology (SCOT) thesis, namely how the norms and values of a variety of social groups "interpreted" the rigid airship and ultimately shaped its development in the United States.[206]

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[202] Robinson and Keller, *"Up Ship!,"* 194; Trimble, *Admiral W. A. Moffett,* 200–29.

[203] Robinson and Keller, *"Up Ship!,"* 115.

[204] Duggan and Meyer, *Airships in International Affairs, 1890–1940*; Robinson and Keller, "*Up Ship!*"

[205] Arpee, *From Frigates to Flat-Tops*.

[206] Farrell and Terriff, "Sources of Military Change," 13–14; Kline and Pinch, "The Social Construction of Technology," 113–15; Pinch and Bijker, "Social Construction of Facts and Artifacts," 21–34, 40.

First, the public reaction to airship accidents in the early 1920s, both in the United States and abroad, drove the U.S. government and the Navy Department to establish a national helium policy that mandated its use in rigid airships.[207] Despite an initial preference for hydrogen, the U.S. Navy adopted helium in their airships to appease public sentiment and fight perceptions that the rigid airship was hazardous.[208] The German zeppelins, and most other early lighter-than-air craft, utilized flammable hydrogen gas.[209] Hydrogen, despite its flammability, was cheaper, more readily available, and provided superior lift in comparison to helium.[210] Helium, in contrast, reduced a rigid airship's operational range by 40% and cost $120 per 1,000 cubic feet.[211] Filling the *Shenandoah* with helium cost over $240,000 with recurring expenditures due to the loss of helium during normal operations and storage.[212] Despite helium's shortcomings, the Navy Department established a helium production plant in Fort Worth, Texas by 1921 to support the War and Navy Department's lighter-than-air operations.[213] In March 1925, Congress passed the Helium Conservation Act that transferred control of the Navy's Fort Worth facility to the U.S. Bureau of Mines and sought greater efficiency of helium extraction during natural gas production.[214] In 1927, Congress deemed the element so critical to national defense that it passed the Helium Act banning helium's exportation, with eventual fatal consequences for the rigid airship programs of Germany and Great Britain.[215]

Two factors drove the American government's turn towards helium. First, the United States discovered it had a monopoly on the world's helium with the only significant known

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[207] Althoff, *Sky Ships*, 27–28; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 90–91; Robinson and Keller, *"Up Ship!,"* 61–63.

[208] Robinson and Keller, "*Up Ship!*," 61.

[209] Ibid., xii.

[210] Hydrogen cost $2.00-$3.00 / 1,000 cubic feet. Robinson, *Giants in the Sky*, 194; Robinson and Keller, *"Up Ship!,"* 62–63.

[211] Robinson, *Giants in the Sky*, 194; Robinson and Keller, *"Up Ship!,"* 62–63.

[212] Robinson, *Giants in the Sky*, 194–95.

[213] Robinson and Keller, *"Up Ship!,"* 62; Sears Jr., *Helium: The Disappearing Element*, 103.

[214] Sears Jr., *Helium: The Disappearing Element*, 106–07.

[215] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 91; Eckener, *My Zeppelins*, 174–84; Sears Jr., *Helium: The Disappearing Element*, 107.

reserves, 90% of global supply, being located in Texas, Colorado, and Kansas.[216] Second, and primarily, a string of airship accidents from 1921–1923 involving hydrogen drove the United States to use helium exclusively.[217] These accidents included: 1) the explosion and crash of the ZR-2 (R38) in August 1921 resulting in the deaths of 44 British and American aviators;[218] 2) the destruction of the Navy's non-rigid airship D6 in a hydrogen fire also in August 1921;[219] 3) the U.S. Army Air Service's *ROMA*, exploded after descending into high-voltage power lines in February 1922 with 34 killed;[220] 4) the loss of the U.S. Army's C2 non-rigid airship in a hydrogen fire in October 1922;[221] and 5) the French *Dixmude*, a German war reparations zeppelin (L-72), exploded over the Mediterranean in 1923 with 50 aboard.[222] In sum, 128 personnel had died in five hydrogen-related airship crashes over the course of 29 months. The public reaction against rigid airships was significant, but the reaction against hydrogen as a lifting gas was overwhelming.[223]

The U.S. government, already invested in the Navy's rigid airship program, responded to the public outcry as early as 1922 with an "informal discussion" at the White House regarding bulk helium production for airship use.[224] The Navy reactivated the Fort Worth Plant in October 1922 after Secretary of the Navy Edwin Denby publicly announced his desire to prevent "send[ing] any of the big dirigibles up without helium gas."[225] Despite the general preference for hydrogen among airship personnel, BuAer immediately sought to sell the safety

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216 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 91; Robinson, *Giants in the Sky*, 185; Robinson and Keller, "*Up Ship!*," 62; Sears Jr., *Helium: The Disappearing Element*, 107.

217 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 90.

218 Robinson, *Giants in the Sky*, 330–42; Robinson and Keller, "*Up Ship!,*" 62.

219 Robinson and Keller, "*Up Ship!*," 62.

220 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 90–91.

221 Robinson and Keller, "*Up Ship!,*" 62.

222 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 87, 90; Lehmann and Mingos, *The Zeppelins*, 317; Robinson, *Giants in the Sky*, 347–49; Robinson and Keller, "*Up Ship!,*" 137.

223 Robinson and Keller, "*Up Ship!*," 61, 63.

224 Ibid., 62.

225 Ibid., 63.

of the rigid airship, through the sole utilization of helium, to the public and Congress.[226] By 1923, according to Duggan and Meyer, "helium became the propaganda byword for successful naval airship operation."[227]

Subsequently, the *Shenandoah*, designed to use hydrogen, became the first rigid airship to use helium when she launched in September 1923.[228] Her crews would pioneer techniques to fly with, and conserve, the inferior and more expensive lifting gas during the airship's brief existence.[229] According to Robinson and Keller, "the remarkable expedients to which American airshipmen had to resort to conserve helium … compromised the performance of the ships, and at times threatened their safety."[230] To make matters worse, the Fort Worth Plant's production capacity was initially so limited that the Navy could not fill two rigid airships simultaneously.[231] For the brief window in 1924–1925 when both the *Los Angeles* and *Shenandoah* were operational, one airship had to be deflated, in what was called a "helium waiting" status, so that the other could have enough helium to fly.[232] Ultimately, BuAer and the Navy Department transitioned their rigid airship program to helium to conform to societal perceptions of safety at the loss of considerable operational efficiency and effectiveness. This, in turn, created new risks in the reduced range and performance of the Navy's rigid airships. These events and decisions reflect the manner in which the stimuli provided by a variety of social groups guided rigid airship development along a socially constructed, and "multi-directional," innovation path consistent with the SCOT concept of Pinch and Bijker.[233]

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[226] Robinson, *Giants in the Sky*, 194; Robinson and Keller, *"Up Ship!,"* 61–62.

[227] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 91.

[228] M. Ernest Marshall, *Rear Admiral Herbert V. Wiley: A Career in Airships and Battleships*, ed. Paul J. Springer, The History of Military Aviation (Annapolis, MD: Naval Institute Press, 2019), 37; Robinson, *Giants in the Sky*, 189–91; Robinson and Keller, *"Up Ship!,"* 61.

[229] Robinson, *Giants in the Sky*, 194–95.

[230] Robinson and Keller, *"Up Ship!,"* 63.

[231] Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1925)," 23; Robinson and Keller, *"Up Ship!,"* 96.

[232] Althoff, *Los Angeles*, 48–49; Robinson and Keller, *"Up Ship!,"* 96.

[233] Kline and Pinch, "The Social Construction of Technology," 113–15; Pinch and Bijker, "Social Construction of Facts and Artifacts," 22.

Next, American and naval culture, at least as exhibited by statements of the U.S. Congress and Admiral Moffett, did not react to the losses of the ZR-1 and ZR-2 as triggers to terminate the rigid airship program. Rather, decision-makers viewed these losses primarily as sacrifices in the name of progress. The reaction of Congress and the Navy was to continue the program in honor of the fallen and in pursuit of furthering the commercial and military vitality of the United States of America.[234] Decision-makers viewed terminating the program as an "un-American" admission of failure and the waste of the lives and resources previously expended.[235]

Admiral Moffett's argument for rigid airships after the *Shenandoah* disaster had two aspects that represented specific norms and values: 1) the long-standing connection between the U.S. Navy and American commerce and 2) the American duty to persevere in the face of adversity. The linkage between the U.S. Navy and American commerce had been a well-established norm since A.T. Mahan wrote about sea power and its relation to "the peaceful commerce and shipping from which alone a military fleet naturally and healthfully springs, and on which it securely rests."[236] Moffett, potentially adapting this mentality to the aerial age, believed that the creation of an American airship industry required the Navy's leadership to encourage the commercial sector to take the next steps.[237] His note from the 1926 Annual Report of the Bureau of Aeronautics explains his rationale after the *Shenandoah* crash:

> It is believed that the Nation will profit greatly by the construction of these airships. The Government will demonstrate its confidence in the military usefulness of rigid airships and its belief that they can be built in this country of American-made materials with assurance that they will be safe and in all respects air worthy. The successful operation of such airships by the Navy will encourage private industry to take up the development of this type of aircraft for commercial purposes. The commercial development of the lighter-than-air side of aeronautics has lagged in this country and needs to be encouraged.[238]

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234 Arpee, *From Frigates to Flat-Tops*; Rosendahl, *Up Ship!*.

235 From H.R. 9690 and Report No. 389 (1926) excerpt in *From Frigates to Flat-Tops*, 208.

236 Alfred Thayer Mahan, *The Influence of Sea Power Upon History 1660–1783* (London: Sampson Low, Marston & Co., Ltd., 1890), 28.

237 Trimble, *Admiral W. A. Moffett*, 95.

238 Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1926)," 42.

With the belief that the continuing military and commercial vitality of America was at stake, the value of perseverance is also understandably apparent in Admiral Moffett's other statements and writings. Following the *Shenandoah* disaster Moffett made the following statement in Washington, DC:

> This disaster took the heart out of the enterprise for some, yet I cannot see why it should. Certainly it would have been disastrous for progress if the first airplane crash had stopped the development of the heavier-than-air machine. This country has not advanced through timidity. We have had pioneers in every age. The covered wagons that plowed through trackless prairies did not stop because Indian bands murdered the hindermost. The rigid airship today fills a gap in transportation need that can be filled by no other means. *We must find our permanent place in the sky*.[239]

Moffett's speech provides evidence of a propagandist's clever use of stereotypes and/or a deep conviction in the rigid airship program.[240] In either case, his statement provides evidence of the Admiral's values, specifically in reference to sacrifice and perseverance. Further evidence of his belief in perseverance, and a sense of American aerial manifest destiny, is apparent in an unpublished memorandum from 1930:

> If we Americans today, have the spirit of the early pioneers, navigators and seamen, who made America possible, we too will carry on for what they have accomplished and for their supreme sacrifice, and with our great riches not turn aside from the opportunity and the duty is ours–to complete the two airships [ZRS-4 and 5] authorized by Congress, so that the sacrifice of our own Maxfield [killed on ZR-2], Lansdowne [killed on ZR-1], and their brave companions, our men, and of ... others, will not have been in vain.[241]

Moffett was not alone in his norms, values, and perceptions of the rigid airship program. LCDR C.E. Rosendahl, the only officer who survived the *Shenandoah* crash, provided the following joint statement of the crash's survivors to the Navy's subsequent court of inquiry in 1925:

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239 Italics as written in the source. Arpee, *From Frigates to Flat-Tops,* 200.

240 Edward Bernays, *Crystallizing Public Opinion* (New York: Ig Publishing, 2011); *Propaganda* (New York: Ig Publishing, 2005); Walter Lippmann, *Public Opinion* (New York: The Macmillan Company, 1922; repr., February, 1947).

241 Arpee, *From Frigates to Flat-Tops,* 214.

> Although we are survivors of one of the worst air accidents that has ever occurred, we nevertheless have not lost faith in rigid airships and are still of the opinion that rigid airships are of a great deal of value for naval and commercial purposes as well. It would be in keeping with neither tradition nor sound business to abandon at this stage an enterprise on which such an immense amount of effort has already been expended and which with slightly more expenditure along the present lines, will bring forth the potential value and possibilities of this type of aircraft. We … are ready to do and give our utmost toward the continuing and furthering of this project and we urge … the retention, continuation and furtherance of rigid airship development and operation in the Navy.[242]

Moffett's norms and values aligned with the policymakers of Congress, and he was successful in gaining support for the new airships *Akron* and *Macon*. The text of H.R. 9690, which authorized the continuation and, indeed, significant expansion of the Navy's rigid airship program stated the following:

> The committee does not feel that the *Shenandoah* crash of last September [1925] should discourage further experiments with airship navigation … money and lives are not wasted if only the work goes on. They are wasted if the work is abandoned. … The committee believes there is definite public sentiment in favor of replacing the *Shenandoah* by a larger and thoroughly modern rigid airship. To stop this worthy development in the face of misfortune would be un-American. If such tactics had been followed in the past, many of the machines which serve commerce today would be non existent.[243]

In the end, the socio-cultural linkage between the norms and values of the Navy and the American Congress combined in the furtherance of the rigid airship program. The Navy allowed public sentiment to shape its development and utilization of the rigid airship in order to create perceptions of safety and gain public acceptance. Primarily, the Navy did this initially by adopting helium over the flammable, but significantly more efficient and effective, hydrogen.[244] After the losses of two of the Navy's first three rigid airships, Moffett fell back on the foundational norms and values of his institution, if not the nation. Moffett exhibited

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[242] Rosendahl, *Up Ship!*, 94.

[243] Excerpt of HR 9690 and Report No. 389 (1926) from Arpee, *From Frigates to Flat-Tops*, 208; Rosendahl, *Up Ship!*, 96–98.

[244] Duggan and Meyer, *Airships in International Affairs, 1890–1940*; Robinson, *Giants in the Sky*; Robinson and Keller, "*Up Ship!*".

two beliefs: 1) that the Navy must play a role in stimulating and securing the commercial vitality of the United States in the new air age; and 2) that the Navy must persevere in rigid airship development, which he viewed as essential to future commerce.[245] Moffett's expressed beliefs, whether genuine or clever manipulation, aligned with the norms and values of civilian decision-makers to such an extent that they were willing to authorize two more rigid airships, larger than any before, and a new airship base on the West coast.[246] As LCDR Rosendahl wrote, "Airships owe their recognition and status in this country, to only a few persistent invincible believers and doers, headed by Admiral Moffett" and that without Moffett's "vision, enthusiasm and determination" the program would not have survived beyond the setbacks of the 1920s.[247]

F. SYNTHESIS AND CONCLUSION

In conclusion, empirical evidence shows that the combination and interaction of civil-military, inter-service, and socio-cultural dynamics sustained and propelled the Navy's rigid airship program beyond the crash of the *Shenandoah* and the "LTA Crisis of 1925–1926."[248] Unlike in the program's incipient phase (1900–1919), civilian policymakers, including President's Harding and Coolidge, took an active interest in the rigid airship and intervened to ensure the program's survival.[249] In addition, presidential-level intervention occurred in response to the publicly disruptive inter-service rivalry between the Navy and War Departments and General Billy Mitchell.[250] The Navy, in its quest to thwart Mitchell and the War Department's expanding aerial ambitions, formed the Bureau of Aeronautics and refused

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245 Trimble, *Admiral W. A. Moffett*.

246 The new base would be at Sunnyvale, California. Robinson and Keller, *"Up Ship!"*; Rosendahl, *Up Ship!*, 98–103.

247 Rosendahl, *Up Ship!*, 95, 103.

248 Smith, *The Airships Akron & Macon*, 9.

249 Arpee, *From Frigates to Flat-Tops*, 191; Lehmann and Mingos, *The Zeppelins*, 325; Robinson and Keller, *"Up Ship!,"* 120; Smith, *The Airships Akron & Macon*, 17.

250 Hurley, *Billy Mitchell*; Trimble, *Admiral W. A. Moffett*; Wildenberg, *Billy Mitchell's War with the Navy*.

to terminate the rigid airship program.[251] Lastly, the norms and values of a variety of social groups interacted in shaping the emerging rigid airship technology.[252] The Navy's desire to present a safe and efficient platform for commercial use led BuAer to switch its rigid airships to helium in response to political and social pressures against hydrogen use.[253] Furthermore, Admiral Moffett, his lighter-than-air aviators, and supporters in Congress all shared the same belief in the necessity to continue the program despite the loss of millions of dollars and 30 American lives from 1921–1925.[254] Conversely, the intra-service dynamics that had nurtured the rigid airship concept from 1900–1919 began to erode in the fiscally constrained environment of the 1920s.[255] Furthermore, Moffett's success in creating BuAer and building naval aviation, was also building a cadre of ardent believers in heavier-than-air and aircraft carriers who did not share Moffett's vision that rigid airships were a necessary component in a balanced system of naval aviation.[256]

The next chapter examines how these forces continued to evolve in the 1930s, along with the strategic environment and military aviation, in the final phase of the rigid airship's innovation process. It endeavors to determine which force, if any, primarily resulted in the program's termination. From 1931–1939, the Navy made its final attempt to secure the future of rigid airships in America. However, as this chapter indicates, leaders based the rigid airship's future more on the hopes and beliefs in the airship's potential than on any tangible evidence.[257] The question is, how long would this behavior continue in the 1930s? What forces ultimately and decisively shifted the Navy Department away from the rigid airship?

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[251] Arpee, *From Frigates to Flat-Tops*, 88–112; Davis, *The Admirals Lobby*, 73–100; Smith, *The Airships Akron & Macon*, 9–13; Trimble, *Admiral W. A. Moffett*, 64–86; Turnbull and Lord, *History of U.S. Naval Aviation*, 186–92.

[252] Farrell and Terriff, "Sources of Military Change"; Kline and Pinch, "The Social Construction of Technology"; Pinch and Bijker, "Social Construction of Facts and Artifacts."

[253] Robinson, *Giants in the Sky*; Robinson and Keller, *"Up Ship!"*.

[254] Robinson and Keller, *"Up Ship!,"* 45–46, 49, 50–115.

[255] Davis, *The Admirals Lobby*, 73–100.

[256] Robinson and Keller, *"Up Ship!,"* 67; Trimble, *Admiral W. A. Moffett*, 274; Rosen, *Winning the Next War*, 76–105.

[257] Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*; Trimble, *Admiral W. A. Moffett*.

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IV. EMPLOYMENT AND TERMINATION (1929–1939)

> I made it perfectly clear, and have done so for two years, that I do not approve the construction of another large rigid airship for the Navy.
>
> —President Franklin D. Roosevelt to
> Secretary of the Navy Charles Edison (1939)[1]

A. INTRODUCTION

This chapter examines the final phase of the U.S. Navy's rigid airship program (1929–1939) and demonstrates that, in the end, all of the forces that had previously sustained the program turned against it. In 1926, Admiral William A. Moffett secured a final opportunity for the Navy's rigid airships with his Five-Year Aircraft Program.[2] The Navy's next airships, built by Goodyear-Zeppelin, would be the largest helium-filled airships ever flown, with a length of 785 feet and a gas volume of 6.85 million cubic feet.[3] They were 100 feet longer, and had three times more lift, than the earlier airships *Shenandoah* and *Los Angeles*.[4] The ZRS-4 (*Akron*) and ZRS-5 (*Macon*) would be capable of transporting up to 160,644 lbs., and flying more than 4,000 nautical miles, at a speed of 70 knots.[5] Most importantly, the *Akron* and *Macon* would be aerial aircraft carriers. They were each capable of carrying four F9C-2 fighters, in an internal hangar, that could be launched and recovered in flight using a "trapeze" and hook system.[6] The *Akron* and *Macon* represented the pinnacle of the military development of rigid airship technology. However, both airships failed to gain the acceptance of the Fleet and were destroyed in accidents that took the lives of 75 officers and men, including Admiral Moffett.[7] Yet the losses of the *Akron* (1933) and *Macon* (1935) did not

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[1] Smith, *The Airships Akron & Macon*, 167.

[2] Trimble, *Admiral W. A. Moffett*, 167–99; Turnbull and Lord, *History of U.S. Naval Aviation*, 259–69.

[3] Smith, *The Airships Akron & Macon*, 181–83.

[4] Robinson and Keller, *"Up Ship!,"* 204–06; Smith, *The Airships Akron & Macon*, 181–83.

[5] Smith, *The Airships Akron & Macon*, 183.

[6] Ibid., 19–30.

[7] Robinson, *Giants in the Sky*, 330–43.

solely, or decisively, terminate the program as might be expected. While the accidents did critically undermine confidence in the rigid airship, some leaders, like Admiral Ernest J. King, would continue to fight for new rigids into the 1940s.[8] Nevertheless, from 1929–1939 all of the forces of innovation gradually aligned against the rigid airship leading to the program's termination.

As in previous chapters, this chapter examines the events and actions surrounding the Navy's rigid airship program from 1929–1939 through the four paradigms of military innovation including their civil-military,[9] inter-service,[10] intra-service,[11] and socio-cultural dynamics.[12] Unlike previous phases of development, by the 1930s all of the dynamics of military innovation turned against the rigid airship. First, with changes in the strategic environment, and the failures of the *Akron* and *Macon*, civilian leaders like President Franklin D. Roosevelt actively intervened to terminate the program.[13] Second, the nature of the inter-service rivalry between the War and Navy Departments evolved from 1929–1939. Fundamentally, the services shifted their competition towards long-range, heavier-than-air capabilities rather than rigid airships.[14] Accordingly, the Navy Department's incentive to retain the program to prevent the Army from acquiring it disappeared.[15] Third, the internal resistance to rigid airships within the Navy Department and the Bureau of Aeronautics (BuAer) intensified in the 1930s, especially after the death of Admiral Moffett in 1933.[16] Lastly, socio-cultural factors compounded to undermine the program and the concept of the rigid airship in general. Lighter-than-air officers interpreted the airplane carrying airship in

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8 Smith, *The Airships Akron & Macon*, 163–78.

9 Posen, *Sources of Military Doctrine*.

10 Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*.

11 Rosen, *Winning the Next War*.

12 Adamsky, *Culture of Military Innovation*; Farrell and Terriff, "Sources of Military Change"; Grissom, "The Future of Military Innovation Studies."

13 Smith, *The Airships Akron & Macon*, 163–70.

14 Greer, *Air Doctrine*, 46–47; Miller, *War Plan Orange*, 178–79; Wildenberg, *Billy Mitchell's War with the Navy*, 167–77.

15 Smith, *The Airships Akron & Macon*, 9–13.

16 Ibid., 173.

significantly divergent manners leading to the discrediting of the system in the eyes of the Fleet.[17] Furthermore, the organizational and institutional pressures on rigid airship commanders to make their ships perform led to increased risk-tolerance and disaster.[18] Lastly, the accumulation of airship disasters by the 1930s created a lasting and significantly negative perception of the technology.[19] In the end, the U.S. Government, military, and society were no longer willing to accept the costs of developing what appeared to be a fatally flawed platform. America, consequently, turned to heavier-than-air transport for its commercial and military needs in the future.

B. CIVIL-MILITARY DYNAMICS: TREATIES, DEPRESSION, AND WAR

Civilian interventions once again played a prominent role, if not the deciding role, in the final phase of the rigid airship program. While some early civilian interventions favored the rigid airship, after the loss of the *Akron* (1933) policymakers began to change their position.[20] The subsequent loss of the *Macon* (1935) critically undermined the future of the military rigid airship in America.[21] The explosion of the German *Hindenburg* at Lakehurst in 1937, and the ongoing Great Depression, did little to help efforts to revive the program.[22] Despite some commercial and half-hearted U.S. Navy efforts in the late 1930s to acquire further airships, decision-makers put a stop to any further military development.[23] The geostrategic situation had grown too volatile for continued development of expensive military systems of unproven value. The increasing aggression of fascist Germany, Italy, and Japan coincides with the demise of the rigid airship program as well as the U.S. Navy's escape from

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17 Kline and Pinch, "The Social Construction of Technology," 113–15; Pinch and Bijker, "Social Construction of Facts and Artifacts"; Smith, *The Airships Akron & Macon*, 63–75, 171–78.

18 Arpee, *From Frigates to Flat-Tops*, 235.

19 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 1–18; Smith, *The Airships Akron & Macon*, 171–78.

20 Smith, *The Airships Akron & Macon*, 77–92.

21 Ibid., 147–70.

22 Robinson, *Giants in the Sky*, 285–95; Smith, *The Airships Akron & Macon*, 163–70.

23 Smith, *The Airships Akron & Macon*, 163–70.

the limitations of international arms agreements.[24] By 1936, the treaties that had made the rigid airship an important component of the Navy's war plans were void.[25] By 1938, the United States government and the U.S. Navy were focused on expansion and preparedness.[26] In 1939, war in Europe broke out. Despite President Franklin D. Roosevelt's emphasis on the massive expansion of America's military aviation, there was no place for the rigid airship in the United States' preparations for war.[27] Civilian policymakers had finally ruled, decisively, in favor of the easily mass-produced airplane and against the rigid airship.

In the late 1920s and early 1930s the future of the rigid airship in America, and the world, seemed promising.[28] The United States Navy contracted with Goodyear-Zeppelin in 1928 to build the world's largest rigid airships, at a cost of $7,825,000, in Akron, Ohio.[29] In 1929, Dr. Hugo Eckener of Germany's Zeppelin Company completed a circumnavigation of the world, beginning and ending at the Statue of Liberty in New York Harbor.[30] Great Britain had completed two large commercial rigid airships, the R100 and R101, to connect its empire by lighter-than-air transport.[31] R101, however, crashed and exploded in France after eight hours in the air on its first flight to India in October 1930.[32] Lord Thomson, the politician responsible for Great Britain's rigid airship program, and 47 others died in the crash that ended England's large airship development.[33] Nevertheless, in America civilian investors looked to establish rigid airship passenger, mail, and freight services to Europe and the Far East with the creation of the International Zeppelin Transport Company and the Pacific Zeppelin

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[24] Turnbull and Lord, *History of U.S. Naval Aviation*, 296.

[25] Baer, *One Hundred Years of Sea Power*, 133.

[26] Ibid., 134.

[27] Greer, *Air Doctrine*, 100–01; Turnbull and Lord, *History of U.S. Naval Aviation*, 300–07.

[28] Smith, *The Airships Akron & Macon*, 31.

[29] Robinson, *Giants in the Sky*, 226–28; Robinson and Keller, *"Up Ship!,"* 178–79, 207.

[30] Robinson, *Giants in the Sky*, 271–74; Eckener, *My Zeppelins*, 67–94; Smith, *The Airships Akron & Macon*, 31.

[31] Robinson, *Giants in the Sky*, 296–315.

[32] Ibid.

[33] Ibid., 311–15.

Transport Company.[34] Congressmen proposed the Merchant Airship Act (1932) to "provide legal status for the airship as a carrier of passengers, mail and express."[35] In spite of the onset of the Great Depression in 1929, the rigid airship seemed to have a promising commercial and military future.

The first significant civilian intervention came in the form of the London Naval Conference of 1930 and actually benefited the Navy's rigid airships. President Herbert Hoover's emphasis on naval disarmament, specifically cruiser reductions, at the London Conference added to the apparent military necessity of airships for naval planners.[36] The United States and Great Britain had transferred their naval competition to cruiser construction in the 1920s, and the arms race threatened the stability that the Washington Conference established in 1922.[37] After the stock market crash of November 1929, President Hoover became increasingly interested in methods to ensure international stability and reduce government expenditures.[38] The U.S. military, according to Hoover, existed only to prevent the invasion of the continental United States and the violation of the Monroe Doctrine.[39] Accordingly, Hoover's primary target was military spending, and he viewed international cooperation via disarmament as a viable mechanism to cut costs and prevent war.[40]

At the London Naval Conference President Hoover overrode the majority opinion in the U.S. Navy that it needed more cruisers to meet the reconnaissance and screening requirements of the U.S. Fleet in the Pacific.[41] As a result of the treaty: 1) the suspension of battleship construction continued until 1936; 2) America agreed to limit its heavy cruiser

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[34] The President of the International Zeppelin Transport Company was P.W. Litchfield. Jerome Hunsaker, formerly of the U.S. Navy, was vice president and general manager. Allen, *The Story of the Airship*, 74–78.

[35] Ibid., 78; Litchfield, *Industrial Voyage*, 247–48; Smith, *The Airships Akron & Macon*, 213.

[36] Smith, *The Airships Akron & Macon*, xx-xxi.

[37] Fanning, *Peace and Disarmament*, 11–16; Martin L. Fausold, *The Presidency of Herbert C. Hoover*, ed. Donald R. McCoy, Clifford S. Griffin, and Homer E. Socolofsky, American Presidency Series (Lawrence: University Press of Kansas, 1985), 172.

[38] Baer, *One Hundred Years of Sea Power*, 113–18; Trimble, *Admiral W. A. Moffett*, 211.

[39] Baer, *One Hundred Years of Sea Power*, 113, 22.

[40] Ibid., 113–18.

[41] Ibid.

construction to 18 vessels; and 3) the United States agreed that it would not build to authorized treaty strength until after 1936.[42] The result gave the Imperial Japanese Navy a regional advantage in cruiser strength and threatened the United States' ability, in accordance with War Plan ORANGE, to cross the Pacific, locate, and destroy the Japanese Fleet.[43] While the London Naval Treaty undermined the American Navy's plans, it seemed to validate the Navy's decision to pursue rigid airships that, hypothetically, could reconnoiter 129,000 square miles of ocean in twelve hours.[44] War plan ORANGE, accordingly, adjusted to reflect the construction of eight additional American ZRS-type airships to provide a 1200-mile screen line for the American fleet as it advanced across the Pacific.[45] Theoretically, 10 of these airships, with their 40 fighters, could perform the work of 40 cruisers in one-third the time.[46]

However, under President Franklin D. Roosevelt, civilian sentiment began to turn against the rigid airship with the crash of the *Akron* and the death of Admiral Moffett in 1933. The *Akron*'s crash, and the loss of 73 lives in a single aviation disaster, created an immense and negative public reaction against rigid airships in the United States.[47] After the *Akron*'s destruction, Carl Vinson, the Chairman of the House Committee on Naval Affairs told *Newsweek*, "We've built three and lost two; you can take it from me, there won't be any more airships built."[48] While Vinson was technically correct in terms of new construction, subsequent congressional investigations recommended the opposite.[49] Congressman William H. King, who loathed military expenditures and rigid airships, led the investigative committee.[50] However, in a surprise outcome, the committee recommended the program

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[42] Ibid., 114–15.

[43] Ibid., 117–18, 120–23.

[44] Smith, *The Airships Akron & Macon*, xxi.

[45] Baer, *One Hundred Years of Sea Power*, 140; Miller, *War Plan Orange*, 177; Smith, *The Airships Akron & Macon*, xxii.

[46] Smith, *The Airships Akron & Macon*, xxii.

[47] Ibid., 77, 80–82.

[48] Ibid., 92.

[49] Mrs. Moffett christened the *Macon* on March 11, 1933 before the *Akron* crashed on April 4, 1933. Ibid., 91.

[50] Ibid., 89.

should continue with the replacement of the *Akron* and the construction of a smaller training airship.[51] Furthermore, the committee recommended the reactivation of the *Los Angeles*, which had been decommissioned in 1932 after the arrival of the *Akron*.[52] Congress, however, never acted on the committee's recommendations and the rigid airship's reprieve was brief.

On February 12, 1935, the *Macon* suffered structural failure and crashed into the Pacific Ocean off Point Sur, California.[53] While only two men of the 83 aboard lost their lives in the accident, the public and political reaction was essentially a mortal wound to the rigid airship program.[54] Supporters who had previously defended the program now turned on it. Most notably was President Roosevelt. Roosevelt had been Assistant Secretary of the Navy when the program began in 1919 and had unsuccessfully attempted to start his own rigid airship transportation service in the 1920s.[55] After the *Macon*, Roosevelt made his opinion clear, "there is no thought at the present time of asking Congress for an appropriation for another airship … we would like to put that money into long-range patrol planes."[56] Carl Vinson, echoing his sentiments from 1933 after the *Akron* crash, stated, "the curtain has been rung down on the lighter-than-air craft in the Navy."[57] At the second London Naval Conference (1935–1936) the Japanese would demand naval parity with Great Britain and the United States.[58] The West's subsequent denial led the Japanese to walk out of the conference, and the Treaty System disappeared along with its limitations.[59]

Nevertheless, some decision-makers continued to advocate for new rigid airships in the Navy. In 1937, the civilian Science Advisory Board, investigating the *Macon* crash and

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[51] Ibid., 91.

[52] William A. Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1932)," ed. Department of the Navy (Washington, DC: Government Printing Office, 1932), 477; Smith, *The Airships Akron & Macon*, 91.

[53] Smith, *The Airships Akron & Macon*, 153; Turnbull and Lord, *History of U.S. Naval Aviation*, 290.

[54] Smith, *The Airships Akron & Macon*, 153.

[55] Meyer, *Airshipmen Businessmen and Politics*, 66–79.

[56] Smith, *The Airships Akron & Macon*, 157.

[57] Ibid., 162.

[58] Baer, *One Hundred Years of Sea Power*, 131–33.

[59] Ibid.

rigid airships in general, ultimately recommended continuing rigid airship development in the United States and the Navy Department.[60] BuAer proposed a Five Year Airship Program (1937–1941) that included the construction of two new ZRS-type rigid airships, six non-rigid airships, and a smaller training rigid airship.[61] The cost for this program would be $16,750,000 spread over five years.[62] Ultimately, only the request for the 650-foot training airship called the ZRN went forward to Congress.[63] Roosevelt intervened, dictated that the airship could be no longer than 325 feet, and the appropriation process continued.[64] However, with Roosevelt's size limitation the "dwarf ship [would be] a militarily useless joke."[65] The Secretary of the Navy, Charles Edison, appealed multiple times to the President to use the funds to build the airship to BuAer's original specifications so that it would be able to carry aircraft and perform its intended functions.[66] In 1939, President Roosevelt informed Edison, "I made it perfectly clear, and have done so for two years, that I do not approve the construction of another large rigid airship for the Navy."[67] The President then terminated the ZRN project.[68]

Despite intermittent efforts by the Navy Department and Goodyear-Zeppelin to sustain rigid airships, the fight ultimately ended in 1939–1940. With America moving towards war, and the massive expansion of the U.S. Navy under Carl Vinson's bills and President Roosevelt's leadership, there would be no further rigid airship development.[69] President Roosevelt expressed his belief that "the principal pressure," for continuing the program came "from a very few officers and from a very powerful lobby conducted by the rubber company

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[60] Smith, *The Airships Akron & Macon*, 157–62.

[61] Ibid., 165.

[62] Ibid.

[63] Ibid., 167; Turnbull and Lord, *History of U.S. Naval Aviation*, 290.

[64] Smith, *The Airships Akron & Macon*, 167.

[65] Ibid.

[66] Ibid.

[67] Ibid.

[68] Ibid.

[69] There were four bills for naval expansion that came from Congressman Vinson from 1934–1940. Baer, *One Hundred Years of Sea Power*, 128–35; Smith, *The Airships Akron & Macon*, 170.

which is seeking to salvage a fairly heavy speculative investment."[70] Roosevelt also likely contributed to Secretary of the Interior Harold Ickes' continuous refusals to export helium to the *Deutsche Zeppelin Reederi*, which had operated the *Hindenburg*, contributing to the end of the only existing international rigid airship transportation service.[71] Ultimately, the President desired heavier-than-air over lighter-than-air for America's commercial and military purposes.[72] In his Naval Expansion Act of 1938, Roosevelt wanted "to acquire or construct additional naval airplanes including patrol planes … so as to bring the number of useful naval airplanes to a total of not less than 3,000."[73] The same year Congress appropriated $21,000,000 on a single contract, the largest in BuAer's history, to build PBY Catalina Flying Boats for long-range reconnaissance.[74] In 1939 the Navy, rapidly expanding and with war in Europe underway, finally scrapped its last rigid airship the *Los Angeles*.[75] The next year in Ohio the Goodyear-Zeppelin enterprise liquidated.[76] President Roosevelt's intervention in the U.S. Navy's rigid airship program had been decisive and final. The airplane would be the preferred weapon of aerial warfare and method of aerial commerce for the United States, and the world, in the future.[77]

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[70] Meyer suspects FDR's previous dealings with Goodyear-Zeppelin (i.e., the rubber company), discussed in the previous chapter, might have contributed to his decision to eliminate rigid airships in the United States. Meyer, *Airshipmen Businessmen and Politics*, 241–42; Smith, *The Airships Akron & Macon*, 169.

[71] The Zeppelin Company (*Luftschiffbau-Zeppelin*) became the *Deutsche Zeppelin Reederi* under Adolf Hitler. Roosevelt ultimately deferred the decision of helium export to the Helium Commission where Ickes, as chairman, had the ability to veto any decision to export. According to Eckener, Ickes "was fully informed concerning the President's attitude" regarding helium export. Most accounts indicate that Ickes acted alone out of a sense of anti-German paranoia. However, according to McJimsey, Roosevelt was known for "[using] people to achieve his ends" and that according to Arthur Schlesinger, Jr., FDR "played Ickes like a violin." Both Litchfield and Eckener felt that the American refusal to export helium is what ultimately ended the future of the rigid airship. Eckener, *My Zeppelins*, 174–84; Litchfield, *Industrial Voyage*, 249; Sears Jr., *Helium: The Disappearing Element*, 111–12; George McJimsey, *The Presidency of Franklin Delano Roosevelt*, ed. Clifford S. Griffin, Donald R. McCoy, and Homer E. Socolofsky, American Presidency Series (Lawrence: University of Kansas Press, 2000), 124–25.

[72] Meyer, *Airshipmen Businessmen and Politics*, 241–42.

[73] Turnbull and Lord, *History of U.S. Naval Aviation*, 300.

[74] Ibid., 299.

[75] The General Board continued to support rigid airship development until 1947. Smith, *The Airships Akron & Macon*, 169–170.

[76] Ibid., 170.

[77] Meyer, *Airshipmen Businessmen and Politics*, 241–42.

C. INTER-SERVICE DYNAMICS: FROM AIRSHIPS TO BOMBERS

Inter-service rivalry remained constant between the War and Navy Departments into the 1930s as both services continued to compete for missions and funds in the austere economy of the Great Depression.[78] Yet, the nature of the competition evolved, along with aviation technology, and the Army pursued larger and more effective bombers rather than rigid airships. After Mitchell's court-martial in 1925, he remained an active advocate of rigid airships for strategic bombardment until his death in 1936.[79] In 1930, the Army briefly considered the procurement and employment of an airship as an airplane carrier, but took no further action on the concept.[80] After this, the Army-Navy aerial rivalry focused on coastal defense, along with its requisite capabilities, and funding.[81] The active members of the U.S. Army Air Corps were no longer interested in Mitchell's rigid airships performing a role in coastal defense; they wanted large long-range bombers.[82] Simultaneously, the Navy Department became increasingly interested in the development of large all-metal high-endurance seaplanes for bombardment and reconnaissance.[83] While the Navy's rigid airships continued to fly in the early 1930s, the services were already moving on to other platforms to meet their requirements. Ultimately, the Army's transition to heavy bombers for extended operations over the sea may have played a factor in the U.S. Navy's decision to discontinue its rigid airship program. The Army had no desire to develop airships after October 1935 with the arrival of the B-17 Flying Fortress.[84] By 1935, the Navy also had a new platform, the PBY-5A Catalina, a seaplane that offered the Navy a way to counter the Army's perceived

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78 A basic element of inter-service rivalry that Booth and Bacevich wrote about as a potential force for change. Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*; K. Booth, *Navies and Foreign Policy* (London: Croom Helm Ltd., 1977), 148.

79 Hurley, *Billy Mitchell*, 130–35.

80 Smith, *The Airships Akron & Macon*, 21.

81 Wildenberg, *Billy Mitchell's War with the Navy*, 161–77.

82 Baer, *One Hundred Years of Sea Power*, 123; Greer, *Air Doctrine*, 47; Wildenberg, *Billy Mitchell's War with the Navy*, 169.

83 Miller, *War Plan Orange*, 175–79; Wildenberg, *Billy Mitchell's War with the Navy*, 167–68.

84 Greer, *Air Doctrine*, 46–47; Wildenberg, *Billy Mitchell's War with the Navy*, 169.

ambitions of monopolizing long-range bombing and reconnaissance.[85] Consequently, with the loss of the *Macon* in February 1935, neither the Army nor the Navy had a strong reason to resuscitate rigid airships. Technology, and the nature of their inter-service rivalry, had evolved.

In the 1930s, the central conflict between the War and Navy Departments focused on the coastal defense of the United States.[86] Admiral William V. Pratt assumed the role of Chief of Naval Operations (CNO) in September 1931 and firmly supported the notion that naval aviation should be mobile and move with the fleet.[87] He established this notion as official policy in November 1931.[88] According to Wildenberg, under Admiral Pratt, "the primary purpose of air operations … was to develop the offensive power of the Fleet; air defense of shore installations was secondary and would not concern the Navy during peacetime."[89] Subsequently, Pratt reached an agreement with the Army Chief of Staff, General Douglas MacArthur, clarifying the roles and responsibilities of Army and naval aviation concerning coast defense, airplane types, and the contentious topic of shore stations.[90] The Army Air Corps, and War Department, had long viewed the "tendency of the Navy to come ashore," its use of shore stations, and land-based naval aircraft as a threat to Army aviation.[91] Under the MacArthur-Pratt Agreement of 1931, naval aviation would be "based on the fleet and move with it" and leave large, wheeled, and land-based aircraft to the Army.[92] According to General MacArthur, the agreement stated:

> The Army air forces will be land based and employed as an element of the Army in carrying out its mission of defending the coasts, both in the

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[85] Miller, *War Plan Orange*, 178–79.

[86] Baer, *One Hundred Years of Sea Power*, 122–23.

[87] Wildenberg, *Billy Mitchell's War with the Navy*, 158.

[88] Ibid., 159.

[89] Ibid.

[90] Greer, *Air Doctrine*, 68–69; Miller, *War Plan Orange*, 176; Wildenberg, *Billy Mitchell's War with the Navy*, 159–60.

[91] Greer, *Air Doctrine*, 70; Wildenberg, *Billy Mitchell's War with the Navy*, 159.

[92] Miller, *War Plan Orange*, 176; David E. Johnson, *Fast Tanks and Heavy Bombers: Innovation in the U.S. Army, 1917–1945*, ed. Robert Jervis, Robert J. Art, and Stephen M. Walt, Cornell Studies in Security Affairs (Ithaca, NY: Cornell University Press, 1998), 154.

> homeland and in overseas possessions. Through this arrangement the fleet is assured absolute freedom of action with no responsibility for coast defense, while the dividing line thus established enables the air component of each service to proceed with its own planning, training, and procurement activities with little danger of duplicating those of its sister service.[93]

The War Department's General Staff issued guidance, in January 1933, specifying how the Army Air Corps would fulfill its coast defense responsibilities.[94] According to MacArthur's instruction, the Air Corps would develop capabilities for "long-range reconnaissance over land and water in order that approaches to critical areas might be covered 'to the limit of the radius of action of the airplanes.'"[95]

The Army ultimately pursued large multi-engine bombers to fulfill this mission. By 1935, the War Department had established its General Headquarters Air Force (GHQ Air Force) under the command of Brigadier General Frank M. Andrews.[96] Andrews, a firm believer in the heavy, multi-engine, bomber had helped push forward the Army's plans to develop extended-range "reconnaissance bombers."[97] Despite continuing friction and debate between the War and Navy Departments over coast defense into the late 1930s, the Army pushed ahead with bomber development.[98] Initiated in 1933, the War Department's long-range bomber program provided, among other models, the XB-17.[99] The XB-17, tested in 1935 and first fielded in 1936, was capable of flying 250 miles per hour with a service ceiling of 30,000 feet.[100] It could carry 5,000 pounds of bombs 1,700 miles.[101] With the Norden bombsight, which the War Department had to fight the Navy Department to acquire, the B-

93 Greer, *Air Doctrine*, 69.

94 Ibid.

95 Ibid.

96 Ibid., 70.

97 Ibid., 89–94.

98 Ibid.

99 Ibid., 46–47; Johnson, *Fast Tanks and Heavy Bombers*, 154.

100 Greer, *Air Doctrine*, 46–47.

101 Ibid., 47.

17 became a formidable strategic weapon.[102] According to LTC Henry H. Arnold, the B-17 represented, "for the first time in history air power that you could put your hand on."[103] By 1938, the War Department had no need for rigid airships to extend the range of the airplane over the sea. The Secretary of War Harry H. Woodring wrote:

> The military value of [lighter-than-air] craft, other than possibly that of captive observation balloons, has never been established either in this country or abroad. On the other hand, the military value of heavier-than-air craft has been definitely established. The ever-increasing efficiency and wide ranges of use of the latter are causing them to supplant all other means of aerial operations. The War Department has definitely abandoned the idea of employing airships in military operations.[104]

The Navy's perceived threat from the U.S. Army had evolved beyond the need to retain rigid airships.[105] Under Admiral Moffett's successor, Admiral Ernest J. King, BuAer would pursue its own long-range bomber and reconnaissance platforms that were capable of the mobility that the Fleet demanded.[106] This platform became the Consolidated PBY-5A Catalina that first appeared as a prototype six months after Moffett's death in October 1933.[107] King made extensive efforts to develop the PBYs, and transform them into a long-range reconnaissance and strike capability for the U.S. Navy during his time as BuAer Chief (1933–1936).[108] According to Edward Miller, a squadron of PBY Catalinas "could haul twenty-four tons of explosives, almost as much as the air wings of both [the *Lexington* and *Saratoga*], to targets five times more distant."[109] Admiral King urged the Navy Department

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[102] Johnson, *Fast Tanks and Heavy Bombers*, 154; Wildenberg, *Billy Mitchell's War with the Navy*, 166–67.

[103] Greer, *Air Doctrine*, 47.

[104] Sears Jr., *Helium: The Disappearing Element*, 112.

[105] Referring to the Navy's "political feature" for continuing the rigid airship program in 1926. Smith, *The Airships Akron & Macon*, 9–13.

[106] Miller, *War Plan Orange*, 178–79.

[107] The Consolidated Aircraft Co. prototype that led to the PBY-5A first flew in 1933 according to Miller. The actual Consolidated PBY-5A "Catalina" prototype, that saw service in WWII, first flew in 1935 according to Smith. Ibid., 178; Smith, *The Airships Akron & Macon*, 207.

[108] Miller, *War Plan Orange*, 178–79.

[109] See Smith Appendix VI for a comparison of ZRS and PBY performance characteristics. Ibid., 179; Smith, *The Airships Akron & Macon*, 207.

to develop the PBY as a strategic strike platform or risk losing the mission to the Army Air Corps.[110] While the PBY Catalina never did fully evolve, doctrinally, into what King had envisioned, it did take over the rigid airship's strategic reconnaissance mission.[111] In the end, the competition with the War Department over coast defense had turned into a competition for long-range reconnaissance and strategic strike capabilities. New platforms were undermining the rigid airship's appeal, and outperforming the U.S. Navy's existing airships. Accordingly, after the *Macon* crashed in 1935, there was little incentive for either service to reinvigorate the program when cheaper, and demonstrably successful, platforms like the B-17 and PBY-5A were available for investment.[112]

D. INTRA-SERVICE DYNAMICS: FACTIONS AND FAILURE

The intra-service competition between the advocates of carrier aviation, the surface fleet, and lighter-than-air would also critically undermine the Navy's rigid airship program from 1929–1939. Moffett's "theory of victory" regarding offensive carrier aviation had gained a high level of acceptance by the time the *Akron* and *Macon* reached the fleet.[113] Moffett's efforts to create a corps of officers, loyal to naval aviation, created a powerful senior majority that was loyal to carriers and heavier-than-air.[114] Meanwhile the lighter-than-air community lacked representation at virtually any echelon and "hardly exist[ed] as a branch of naval aeronautics."[115] In fleet problems, tailored towards furthering the development of tactical carrier aviation, the strategic lighter-than-air carrier could not compete.[116] Rather than

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110 Miller, *War Plan Orange*, 179.

111 Ibid.

112 Robinson and Keller, *"Up Ship!,"* 195.

113 Grissom, "The Future of Military Innovation Studies," 913; Rosen, *Winning the Next War*, 20.

114 Rosen, *Winning the Next War*, 76–105; Smith, *The Airships Akron & Macon*, 107–09, 171–73.

115 From a memo Smith located with CDR Garland Fulton's papers. Fulton was the Chief of BuAer's LTA Design Section and an extremely influential component of the Navy's rigid airship program. Smith, *The Airships Akron & Macon*, 173.

116 Ibid., 107, 73–75.

adjust scenarios, or evaluate the *Akron* and *Macon* in their intended role as long-range reconnaissance platforms, the Fleet simply allowed them to fail.[117]

By the 1930s, the advocates of heavier-than-air dominated the Navy Department's organizational structures, and used the *Akron* and *Macon*'s performance in exercises to justify program termination.[118] The common vision of the U.S. Navy was crystallizing around the offensive potential of the aircraft carrier and, in a decade of severe fiscal constraints, senior leaders had little patience for expensive platforms that did not align with that vision.[119] After Moffett's death on the *Akron* in 1933, the new Chief of BuAer, Admiral King, continued to demand a "square deal" for the rigid airship and pushed for extensive operations with the Fleet to determine the airship's utility.[120] In spite of King's efforts, the Fleet continued to employ the rigid airship in tactical scouting, and in constricted operational areas, where it would be in direct contact and competition with carrier aviation.[121] Naval planners did not know how to employ the rigid airship, how to test its effectiveness, and they did not make any effort to do so.[122] Despite the innovative efforts of airship officers and pilots in the final months of the program, the Fleet had already decided on the worthlessness of the platform before the *Macon*'s crash in 1935.[123]

The concept of the aircraft carrier as an independent and offensive weapon was already taking hold within the Navy by the time the *Akron* was able to participate in its first exercise with the Fleet in 1932. In Fleet Problem IX (1929), the *Saratoga* launched "the most brilliantly conceived and most effectively executed naval operation in [the Navy's] history" when it independently steamed ahead of the battle line and launched an attack on the Panama

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117 Ibid., 175.

118 Ibid., 171–73.

119 Robinson and Keller, *"Up Ship!,"* 194; Rosen, *Winning the Next War*, 20–21; Smith, *The Airships Akron & Macon*, 171.

120 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 204–05; Smith, *The Airships Akron & Macon*, 17.

121 Smith, *The Airships Akron & Macon*, 173–75.

122 Ibid., 175.

123 Ibid., 173–75.

Canal Zone.[124] According to George Baer, this exercise "established the carrier as a separate offensive striking force."[125] However, the *Saratoga*'s attack was intended to prevent the enemy fleet from getting through the canal, which it did not.[126] Additionally, a combination of submarines, battleships, and the *Lexington*'s aircraft sank the *Saratoga* four times during the exercise.[127] A combination of friendly aircraft and enemy battleships also sank the *Lexington.*[128] The exercise demonstrated that "the vulnerability of the platform was the weak point in carrier doctrine."[129] Nevertheless, advocates of carrier aviation viewed the exercise as a successful validation of the carrier concept.[130] The following year in Fleet Problem X (1930), the Fleet tested the carrier strike-force concept in which "aviation scored heavily against battleships."[131] The next year, during Fleet Problem XI, would be the first time a rigid airship joined the Fleet in a military exercise since 1925.[132]

In Fleet Problem XI (1931), the United States Government finally received approval for the ZR-3 (*Los Angeles*) to participate in military exercises.[133] With David S. Ingalls, the Assistant Secretary of the Navy for Aeronautics, on board the *Los Angeles* flew to join the Fleet in the Panama Canal Zone.[134] During the exercise, the *Los Angeles* managed to locate the enemy's main body and report its location before being destroyed by aircraft from the enemy carrier *Langley*.[135] According to Robinson and Keller, "this was the first reliable report of the enemy main body received … and made possible a successful attack later in the

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[124] Baer, *One Hundred Years of Sea Power*, 142.

[125] According to Admiral William V. Pratt. Ibid., 141.

[126] Ibid., 142.

[127] Ibid.

[128] Ibid.

[129] Ibid.

[130] Ibid.

[131] Ibid.; Turnbull and Lord, *History of U.S. Naval Aviation*, 272.

[132] Robinson and Keller, *"Up Ship!,"* 168.

[133] Ibid.

[134] Ibid.

[135] Ibid., 169–70.

day by the *Lexington*'s aircraft."[136] Nevertheless, after the *Los Angeles*' destruction, Admiral William Pratt removed her from the exercise with the message: "You are sunk … Pleasant voyage."[137] The *New York Times* subsequently published an article entitled "Naval Men Doubt Airship War Value" that, in turn, elicited a response from Assistant Secretary Ingalls.[138] According to Ingalls, the performance of the *Los Angeles*, "definitely establish[ed] the advisability, or rather the necessity, of the continued development and maintenance of lighter-than-air by the United States Navy."[139] With the *Akron* nearing completion, Admiral Pratt felt compelled to write an article defending the rigid airship claiming that "Undefended, slow, obsolete, [the destruction of the *Los Angeles*] would be expected on making tactical contact with combatant ships. It is quite another matter to attack a modern armed airship."[140] Of note, during the exercise the carriers almost ran out of fuel, "became only 50 per cent effective against their attackers," and drew the negative attention of senior naval officers.[141]

Nevertheless, the bulk of the Navy's internal criticism fell on the rigid airship. Senior naval officers like Admiral Frank Schofield, the Commander in Chief, United States Fleet (CinCUS) felt that rigid airships' "appeal to the imagination … [is] not sustained by their military usefulness."[142] Furthermore, according to Schofield, their expense was "out of proportion" to any benefit they could provide the Fleet.[143] Admiral Moffett, recognizing this internal resistance, wrote:

> To a comparatively small group who have had experience with airships or who had studied their possibilities, the performance of the *Los Angeles* was gratifying. To a much larger group, and this group includes a great many who have given no consideration, or only cursory consideration, to airships, the *Los Angeles* merely confirmed pre-conceived opinions that airships

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136 Arpee, *From Frigates to Flat-Tops*, 206; Robinson and Keller, *"Up Ship!,"* 169.

137 It was typical to resurrect units after their "destruction." Robinson and Keller, *"Up Ship!,"* 170.

138 Arpee, *From Frigates to Flat-Tops*, 205; Robinson and Keller, *"Up Ship!,"* 171.

139 Arpee, *From Frigates to Flat-Tops*, 205–06.

140 Ibid., 206.

141 Turnbull and Lord, *History of U.S. Naval Aviation*, 273.

142 Robinson and Keller, *"Up Ship!,"* 171.

143 Ibid.

> either are no good or are of so little practical use that their existence is not justified.[144]

With the *Akron*'s commissioning on Navy Day, October 27, 1931, the continued expense of maintaining the *Los Angeles* no longer seemed necessary.[145] Accordingly, the Navy Department decommissioned the *Los Angeles* in 1932 "in order to effect economies" and she never flew again despite remaining on BuAer's books until her scrapping in the winter of 1939.[146] The task of demonstrating the value of the rigid airship as the eyes of the Fleet passed to the "lighter-than-air carriers" the *Akron* and *Macon*.[147]

However, the Fleet's resistance to the rigid airship continued to manifest itself from 1932–1935 in the handful of exercises that ultimately determined the military utility of the ZRS-type fleet airships. The *Akron* would only participate in two fleet exercises before her crash in April of 1933.[148] BuAer and the Navy Department sent *Akron* on several publicity flights early in her career that undoubtedly undermined her readiness to participate in operations.[149] Furthermore, the *Akron* did not have her trapeze installed until January 1932 and did not receive her compliment of F9C fighters until May 1932.[150] Accordingly, when the *Akron* entered exercises with the Fleet in January 1932 the crew and her commanding officer, CDR C.E. Rosendahl, did not employ them.[151] The January exercise with the Scouting Fleet ended with mixed results.[152] While the *Akron* located the enemy using direct scouting methods, the enemy also located the *Akron*.[153] After an accident at Lakehurst damaged the *Akron*'s tail section in February 1932, she was unable to participate in Fleet

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144 Ibid.

145 Smith, *The Airships Akron & Macon*, 43.

146 Althoff, *Los Angeles*, 158–62; Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1932)," 477; Robinson and Keller, *"Up Ship!,"* 173–74.

147 Smith, *The Airships Akron & Macon*, 29.

148 Ibid., 45–62.

149 Robinson and Keller, *"Up Ship!,"* 179, 82; Smith, *The Airships Akron & Macon*, 40–44, 47–49.

150 Smith, *The Airships Akron & Macon*, 30.

151 Ibid., 51.

152 Ibid., 49–51.

153 Ibid.

Problem XII.[154] When CNO Pratt asked Admiral Schofield how he felt *Akron* could have benefited the Fleet during the exercise, Schofield responded, "the need of the Fleet is not more *Akron*s but more carriers."[155]

In May 1932, the *Akron* flew to the West Coast and to the new lighter-than-air station at Sunnyvale, California.[156] The next month, *Akron* participated in her second, and final, exercise with the Scouting Fleet.[157] Again, the *Akron* failed to employ her aircraft due to CDR Rosendahl's preference for direct observation scouting methods.[158] Subsequently, the *Akron* came under attack by enemy aircraft multiple times confirming senior officers' opinions of the "vulnerability" of the rigid airship in fleet operations.[159] In June 1932, the *Akron* returned to Lakehurst and began an extended period of training while its officers attempted to develop methods for integrating and employing their heavier-than-air elements.[160] In April 1933, the *Akron* crashed at sea in inclement weather due to, *inter alia*, "a deceiving altimeter, leading to a lack of vertical maneuvering room."[161] The *Akron*'s tepid performance in Fleet exercises, and fatal crash, furthered perceptions among the Fleet that even the most modern rigid airships were useless.[162] In addition, Admiral Moffett was gone and would no longer be able to protect the rigid airships or further his balanced vision of naval aviation that included them.[163]

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154 Robinson and Keller, *"Up Ship!,"* 183; Smith, *The Airships Akron & Macon*, 53–55.

155 Smith, *The Airships Akron & Macon*, 55.

156 Ibid., 56–58.

157 Ibid., 58.

158 Ibid., 58, 59.

159 Arpee, *From Frigates to Flat-Tops*, 234–35; Robinson and Keller, "*Up Ship!*," 184; Smith, *The Airships Akron & Macon*, 58–59.

160 Smith, *The Airships Akron & Macon*, 63–75.

161 Analysts believe a low-pressure system led the *Akron's* altimeter to read several hundred feet high. Rosendahl, *What About the Airship?*, 115; Robinson and Keller, *"Up Ship!,"* 186; Smith, *The Airships Akron & Macon*, 85.

162 Smith, *The Airships Akron & Macon*, 59–61.

163 Ibid., 91–92.

The ZRS-5 (*Macon*), commissioned in June 1933, faced an immense challenge in gaining the confidence of the Navy after the *Akron*'s brief and underwhelming performance. Moffett's successor as BuAer Chief, Admiral King, was determined to force the rigid airship to demonstrate its value.[164] King realized that the time for publicity flights was over and that the rigid airship needed to perform or else it would be the end of the program.[165] The new CNO, Admiral William H. Standley, was not an airship supporter and had used his airplanes to attack the *Akron* in the June 1932 Scouting Force exercise.[166] As CNO, Standley gave the *Akron* 10 months to demonstrate her military utility and ordered her to the West Coast in October 1933.[167] Admiral Standley informed Admiral David F. Sellers, the new CinCUS, that the *Macon* was "to be employed to the fullest extent possible in fleet exercises, so that her military value could be determined."[168] Additionally, the CNO ordered Admiral Sellers to prepare a report, due September 1934, on the *Macon*'s performance to inform the future development, or termination, of rigid airships in the U.S. Navy.[169]

Ultimately, the *Macon* participated in seven exercises from 1933–1934 which were designed to highlight the offensive capabilities of carrier aviation in a tactical fleet action.[170] The exercise areas were confined and, accordingly, nullified the strategic reconnaissance capabilities of the rigid airship and its organic aircraft.[171] Despite doctrinal innovations on the part of the *Macon*'s commanders and crew, the *Macon* suffered heavily in the exercises when forced into direct contact with carrier aviation by exercise control measures.[172] In seven exercises, the *Macon* was ruled destroyed nine times, with Admiral Sellers reporting that the

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164 Marshall, *Herbert V. Wiley*, 175–76; Smith, *The Airships Akron & Macon*, 99.

165 Marshall, *Herbert V. Wiley*, 176; Smith, *The Airships Akron & Macon*, 107–09.

166 Smith, *The Airships Akron & Macon*, 58.

167 Ibid., 103.

168 Robinson and Keller, *"Up Ship!,"* 186.

169 Smith, *The Airships Akron & Macon*, 103.

170 Robinson and Keller, *"Up Ship!,"* 186; Smith, *The Airships Akron & Macon*, 107, 26.

171 Smith, *The Airships Akron & Macon*, 107.

172 Ibid., 93–146.

Macon could not survive longer than 12 hours in naval operations against any enemy force.[173] In the end, Admiral Sellers reported to CNO Standley that "the USS *Macon* has failed to demonstrate its usefulness as a unit of the Fleet" and that "the further expenditure of public funds for this type of vessel for the Navy is not justified."[174]

Admiral King defended the *Macon* and insisted that the artificial constraints of the exercises failed to allow the *Macon* to operate as a strategic reconnaissance platform, as intended.[175] Eventually, King managed to convince the General Board that the rigid airship and its aircraft were best suited for strategic reconnaissance over the open ocean and should be re-evaluated in this role rather than in confined tactical scenarios.[176] Admiral Standley disagreed, but eventually consented to test the concept in Fleet Problem XVI scheduled to take place west of the Hawaiian Islands.[177] However, the different factions within the Navy Department continued to view the expensive rigid airship as a competitor for resources.[178] When the General Board supported a request from King to build a new training airship to replace the *Los Angeles*, Admiral Standley denied the request stating that the money would be better spent on "items of greater known value."[179] In the end, the *Macon* never made it to Fleet Problem XVI and the Navy Department never built another rigid airship. On February 12, 1935, the *Macon* suffered a structural failure in her tail section and crashed off Point Sur, California.[180] Admiral Standley expressed his viewpoint to the media:

> This should be a solemn warning to this country with respect to the use of lighter-than-air craft.

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[173] Ibid., 125–26.

[174] Ibid., 125.

[175] Ibid., 125–26.

[176] Ibid., 145; Turnbull and Lord, *History of U.S. Naval Aviation*, 290.

[177] Smith, *The Airships Akron & Macon*, 145.

[178] Ibid., 126, 75.

[179] Ibid., 147.

[180] Only two of 83 men aboard were lost in the crash. Marshall, *Herbert V. Wiley*, 195–203; Robinson and Keller, *"Up Ship!,"* 191–92; Smith, *The Airships Akron & Macon*, 153–55; Turnbull and Lord, *History of U.S. Naval Aviation*, 290.

> I have never approved of the use of lighter-than-air craft for other than commercial purposes, and I am more than ever convinced of their unsuitability for military and naval purposes.[181]

The Navy's subsequent court of inquiry lasted six days, was "perfunctory," and lacked the thoroughness of earlier investigations.[182] According to Smith, the Navy Department responded to the *Macon* crash "like something unpleasant [was] finally done away with [and] needed to be forgotten."[183] Over the next five years, some within the Navy, like Admiral King, would attempt to revive the program.[184] BuAer developed a design for an even larger rigid airship capable of carrying nine dive-bombers, the ZRCV, in an attempt to align lighter-than-air capabilities more closely with the offensive doctrine of the Navy Department.[185] However, with advances in technology and the continued expansion of carrier aviation there was unlikely any real chance of gaining wide support for resuscitating the program.[186] Despite several civilian and military reports from 1937–1940 recommending further development of the rigid airship, the majority of senior naval officers simply ignored them.[187] There was no place for the rigid airship in the Navy Department's "theory of victory" after 1935.[188]

E. SOCIO-CULTURAL DYNAMICS: FROM DREAM TO DISASTER

Socio-cultural dynamics contributed to the termination of the Navy's rigid airship program in three primary ways. First, consistent with the Social Construction of Technology (SCOT) thesis, social groups within the lighter-than-air community interpreted the function of the airplane carrying airship in divergent manners leading to different military applications

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181 Smith, *The Airships Akron & Macon*, 157.

182 Ibid.

183 Ibid.

184 The General Board technically maintained a policy supporting rigid airship development until 1947. However, according to Smith, there was no real "willingness to execute the policy." Ibid., 163–70.

185 Robinson and Keller, *"Up Ship!,"* 194; Smith, *The Airships Akron & Macon*, 163–65, 77–75.

186 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 231–32; Robinson and Keller, *"Up Ship!,"* 194–95.

187 Smith, *The Airships Akron & Macon*, 163–70.

188 Rosen, *Winning the Next War*, 20.

of the technology.[189] This initially led to the inefficient utilization of the ZRS-type rigid airship and to its discredit as a military weapons system.[190] Second, the organizational culture of BuAer, under both Admirals Moffett and King, combined with the hostile culture of the Navy Department to place immense performance demands on the ZRS-type ships and their crews.[191] The organizational pressures to "sink or swim" in the 1930s subsequently influenced the decision-making of rigid airship officers and contributed to the destruction of both the *Akron* and *Macon*.[192] Third, crashes of rigid airships during the 1930s had a profoundly negative impact on the public and political perceptions of rigid airship technology in its competition with heavier-than-air transport.[193] In the end, the cumulative impact of these socio-cultural influences contributed to the ultimate termination of the Navy's rigid airship program, and the ultimate de-legitimization of the rigid airship concept in American society and culture.

First, senior cohorts of airship officers viewed the ZRS-type rigid airship, and its organic aircraft, in a fundamentally different manner than their junior counterparts and attached heavier-than-air pilots.[194] Senior officers, personified by the *Akron*'s first commander, C.E. Rosendahl, emulated German zeppelin tactics of World War I and viewed the rigid airship as the primary reconnaissance platform that should directly observe and track enemy surface units.[195] By the 1930s, with advances in heavier-than-air performance and the wide adoption of fleet-based aviation, German World War I direct-observation techniques

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189 Kline and Pinch, "The Social Construction of Technology," 113–15; Pinch and Bijker, "Social Construction of Facts and Artifacts."

190 Smith, *The Airships Akron & Macon*, 62–63.

191 Ibid.

192 Ibid., 161.

193 Arpee, *From Frigates to Flat-Tops*, 232–33; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 1–18; Robinson and Keller, *"Up Ship!,"* 176, 94–95; Smith, *The Airships Akron & Macon*, 80–82, 92, 155–57, 78.

194 Smith, *The Airships Akron & Macon*, 19–30, 63–75.

195 This could also be considered an example of institutional isomorphism if Rosendahl and other officers were emulating what they perceived as a prestigious German model. Goldman, "Spread of Western Military Models"; Robinson and Keller, *"Up Ship!,"* 160.

were essentially "suicidal."[196] According to Robinson and Keller, Rosendahl's close and regular interaction with German zeppelin operators like Ernst Lehmann and Hugo Eckener likely shaped his preference for these antiquated German methods.[197] In line with his perceptions of rigid airship primacy, Rosendahl viewed the *Akron*'s embarked airplanes as supplemental, defensive in nature, and rarely utilized them during exercises.[198] In the *Akron*'s final exercise with the Fleet, Rosendahl left his aircraft at base only bringing them on board to use their weight as ballast when it was time to land.[199] Accordingly, the Fleet's perceptions of rigid airship vulnerability and obsolescence were reinforced when the *Akron* was engaged and destroyed by enemy aircraft while directly observing enemy surface units.[200]

Conversely, later lighter-than-air officers like the *Macon*'s last commanding officer, LCDR Herbert V. Wiley, interpreted the airplane carrying rigid airship as a completely new platform requiring changes in tactics and doctrine.[201] Wiley worked with other commanders, namely CDR Alger Dresel, and attached heavier-than-air pilots to integrate and employ the rigid airship's aircraft.[202] Heavier-than-air pilots, like LTs Ward Harrigan and Harold Miller, recognized and recommended that the airship's aircraft should take the reconnaissance lead while the rigid airship should function as a command, control, communications, and logistics center.[203] It was not until 1933–1934 that airship officers receptive to this point of view assumed command.[204] Wiley became the first commanding officer of a ZRS-type airship who fully embraced the concept of the "lighter-than-air carrier" and made extensive progress

196 Robinson and Keller, "*Up Ship!*," 160.

197 Lehmann was a former German naval zeppelin commander during World War I. Lehmann and Mingos, *The Zeppelins*; Robinson and Keller, "*Up Ship!*," 160.

198 Smith, *The Airships Akron & Macon*, 51.

199 Ibid., 59.

200 Ibid., 58–59.

201 Ibid., 67–69, 127–46.

202 Ibid., 63–72.

203 Marshall, *Herbert V. Wiley*, 179–80; Smith, *The Airships Akron & Macon*, 28–29.

204 Smith, *The Airships Akron & Macon*, 63–75.

in developing the tactical and doctrinal integration of aircraft with the rigid airship.[205] Wiley explained his rationale in an article for the *U.S. Naval Institute Proceedings* in 1934:

> The airship carrier … has certain advantages over the surface carrier. It does not have to head in to the wind to launch or to recover its planes as both craft are floating in the same medium and, relative to each other, there is no wind. Planes can be operated from it at night with facility equal to that of daylight operation and without bright lights on the airship.
>
> The use of planes to enlarge the scouting area gives enormous advantage to the airship. With five planes, the outfit at present (and more could be provided on present or future ships), one plane can be stationed continuously on each side of the airship. If the visibility is 40 miles and the planes are 80 miles abeam of the airship, this allows the sweep of an area 240 miles wide at a cruising speed of 60 knots.
>
> Covering 172,000 square miles in a day's work is quite a feat for a vessel costing less in men and money than a destroyer![206]

Under Wiley, the *Macon*'s aircraft were capable of performing persistent, beyond line-of-sight reconnaissance through the integration of radio direction-finding equipment, adding external fuel tanks to the F9C-2s, and developing and rigorously training scouting methods.[207] According to Smith, by 1935 Wiley had "fused the airship and her planes into a single instrument of very-long-range search which exceeded the most sanguine hopes of 1932."[208] However, what Wiley and his crew accomplished during his seven months of command was not enough to save the reputation of the rigid airship before the *Macon* crashed into the Pacific Ocean in February 1935.[209] While Wiley's interpretation of the rigid airship ultimately proved successful, Rosendahl and other commanders' earlier application of antiquated methods had already delegitimized the rigid airship in the eyes of the United States

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[205] Marshall, *Herbert V. Wiley*, 179–81; Smith, *The Airships Akron & Macon*, 133.

[206] *The Airships Akron & Macon*, 127; H. V. Wiley, "Value of Airships," *U.S. Naval Institute Proceedings* 60, no. 5 (1934): 669.

[207] They also removed the landing gear on the F9C-2s to reduce weight and extend range. Landing gear were viewed as a superfluous hazard for operations over the water. Smith, *The Airships Akron & Macon*, 127–46.

[208] Ibid., 133.

[209] Ibid., 140–46.

Navy.[210] The *Macon*'s enhanced performance was too late, as bias had already set in among senior decision-makers.[211]

Second, BuAer and the Navy Department placed enormous pressure on their lighter-than-air personnel to demonstrate the worth of the *Akron* and *Macon*, which contributed to increased risk-taking and the prioritization of operations over critical maintenance activities.[212] This institutional pressure, and the resultant decisions of CDR Frank McCord and LCDR Wiley, likely contributed to the loss of both ships.[213] Admiral Moffett began to increase pressure on the lighter-than-air branch as early as 1931:

> We are now at the threshold of a great opportunity, and I feel that all lighter-than-air personnel must realize this or be made to realize it, and see that these ships operate to the fullest possible amount. If they cannot operate as I have indicated, then they are of little value and we might as well abandon them. It may be advisable to take one of these ships out and keep her out, even looking for bad weather, to see what she can do; if necessary protecting the personnel by making everyone on board wear a parachute, so we can actually find out what these ships can really do, and whether or not they are of any value.[214]

The *Akron*'s operational tempo after her commissioning in October 1931 was extremely high for what was still essentially an experimental vessel.[215] Navy senior leaders wanted the *Akron* to fly to Hawaii to join the Fleet in Fleet Problem XIII (1932).[216] They also proposed the *Akron* conduct a 7,000 mile "rim flight" around the continental United States within months of her commissioning.[217] While these events did not occur, the Navy's leadership still pushed *Akron* into fleet exercises before having her internal hangar completed

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[210] Kline and Pinch, "The Social Construction of Technology," 113–15; Smith, *The Airships Akron & Macon*, 45, 173–75.

[211] Smith, *The Airships Akron & Macon*, 173–75.

[212] Arpee, *From Frigates to Flat-Tops*, 235.

[213] Ibid.

[214] A letter from Admiral Moffett to CAPT H.E. Schoemaker, Commander, Lakehurst Naval Air Station, October 17, 1931. Ibid., 237; Trimble, *Admiral W. A. Moffett*, 259–60.

[215] Smith, *The Airships Akron & Macon*, 45–62.

[216] Ibid., 45.

[217] Ibid.

and airplane trapeze installed.[218] In February 1932, Moffett attempted to take members of the House Naval Affairs Committee up in the *Akron* to dispel their concerns about the rigid airship's "military worthlessness."[219] While exiting the hangar "an unexpected and severe wind condition" broke her aft mooring line and caused the *Akron*'s lower tail fin to strike the ground with enough force that it required six weeks of repairs.[220] Afterwards, *Akron* departed for the fleet exercises on the West Coast from May to June of 1932, which only resulted in additional negative attention.[221] Only after this initial burst of activity did BuAer allow the *Akron* and her crew the opportunity to develop and refine internal organizational and operational practices.[222]

During this training period, from January to March 1933, the *Akron* trained and flew for 425 hours with her new commanding officer, CDR Frank McCord, pushing the airship through "all kinds of weather" including a close encounter with a tropical storm.[223] On April 3, 1933, the *Akron* took off with her Executive Officer, LCDR Wiley, and CDR McCord anticipating inclement weather along her route.[224] In the storm system that developed, the *Akron* crashed into the Atlantic Ocean killing Admiral Moffett, CDR McCord, and 71 others aboard.[225] The court of inquiry declared that McCord made an "error in judgment" in deciding to fly into what was an unusually violent storm.[226] According to the court, "this error in judgment was a contributory cause of the loss of the *Akron*."[227] William Trimble notes that, McCord "had enough meteorological information to know that this was no ordinary

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[218] Ibid., 45–47.

[219] Ibid., 51; Trimble, *Admiral W. A. Moffett*, 257.

[220] Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1932)," 476–77; Smith, *The Airships Akron & Macon*, 55; Trimble, *Admiral W. A. Moffett*, 257.

[221] Smith, *The Airships Akron & Macon*, 58–63.

[222] Ibid.

[223] Arpee, *From Frigates to Flat-Tops*, 230; Smith, *The Airships Akron & Macon*, 74.

[224] Arpee, *From Frigates to Flat-Tops*, 239.

[225] Smith, *The Airships Akron & Macon*, 77.

[226] Ibid., 87.

[227] Smith contests the court's findings in his deconstruction of the *Akron's* last hours. Nevertheless, significant navigational errors occurred and the *Akron* did fly into the center of violent storm system resulting in her crash. Ibid., 87–89.

storm but a major disturbance associated with an intense low-pressure area."[228] In the end, it is impossible to determine what, if anything, beyond the welfare of his ship and crew influenced McCord's decision-making in his final hours.[229]

After the loss of the *Akron* and Admiral Moffett, the organizational pressure on lighter-than-air personnel to perform only increased. The fate of the rigid airship program rested entirely on the performance of the *Macon* and her crew.[230] Admiral King, as Chief of BuAer, and CNO Standley wanted the vessel exercised as much as possible to determine her worth.[231] Admiral King wrote, "We have only one airship. We must not be reckless, but if airships are to justify themselves, the *Macon* has got to show more than she has shown."[232] From April 21, 1933 to February 12, 1935, the *Macon* flew 1,798.2 hours and participated in eight exercises with the Fleet.[233] Under LCDR Herbert Wiley, the *Macon* flew 892.2 hours, or 49.6%, of her total operational hours in the last seven months of her existence.[234] Wiley drove the *Macon* hard and achieved significant results in increasing her operational effectiveness. He, and BuAer, knew that any time in the hangar was time not spent with the Fleet.

In September 1934, BuAer determined that the *Macon*'s tail section required additional structural reinforcements and sent parts to Moffett Field, formerly Sunnyvale, with the following guidance:

> While the Bureau hesitates to prescribe the additions of weight which is perhaps unnecessary, since the present structure is considered to be amply strong for any operations over the sea, it does seem wise to provide additional strength in order that the *Macon* may be prepared to carry out any mission without risk of local damage on [the ship's vertical and horizontal fins and Frame 17.5]. Because the work is not urgent, it is considered that it can be accomplished from time to time, as opportunity offers, at the

228 Trimble, *Admiral W. A. Moffett*, 270.

229 Ibid.

230 Marshall, *Herbert V. Wiley*, 175.

231 Ibid.; Robinson and Keller, "*Up Ship!*"; Smith, *The Airships Akron & Macon*.

232 Smith, *The Airships Akron & Macon*, 107.

233 Ibid., 107–46, 80.

234 Ibid., 145–46, 80.

> discretion of the Commanding Officer, and, therefore, will not interfere with operating schedules.[235]

BuAer's ambiguous guidance regarding "wise" but "perhaps unnecessary" repairs, and the *Macon*'s operational demands, compelled Wiley to prioritize operations over maintenance. According to Smith, the *Macon*'s increased operational tempo under Wiley "was obtained by what appeared to be a compromise; the hours in the air so necessary for training, drilling, and experimentation were obtained by delaying the hours on the ground necessary for installing the tail reinforcements."[236] On February 12, the *Macon*'s vertical fin gave way at Frame 17.5 leading to her crash into the Pacific Ocean 34 minutes later.[237] Wiley told the court of inquiry that neither he nor his officers felt the reinforcements were a priority.[238] The drive to prove the *Macon*'s worth had inadvertently led to her destruction.

Lastly, the cumulative psychological impact of airship losses, including the *Akron*, *Macon* and others, irreparably undermined public and political confidence in the rigid airship. During the 1930s, the rigid airship, and aviation more generally, captivated the attention of the American people.[239] According to Robert Wohl, the concept of flight fascinated society with its display of technical advancement, speed, danger, and the offer of escape.[240] Accordingly, the mass media of the 1920s and 1930s formed a heavily symbiotic relationship with aviation.[241] Advances in journalism and communications enabled the American public to rapidly and vicariously experience the successes and failures of the airships through print, film, radio, and photographs.[242] According to Duggan and Meyer, the rigid airships had a

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[235] Ibid., 145.

[236] Ibid., 146.

[237] Ibid., 159.

[238] Ibid., 162.

[239] Robert Wohl, *The Spectacle of Flight: Aviation and the Western Imagination 1920–1950* (New Haven, CT: Yale University Press, 2005).

[240] Ibid., 277–313.

[241] Ibid., 313.

[242] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 2; Wohl, *The Spectacle of Flight*, 313.

powerful subconscious influence on the public due to their enormous size and scarcity.[243] There were 21 rigid airships built globally between 1919–1939.[244] Only "13 attracted wider international public attention … and of these, eight were lost in accidents that were spectacularly publicized."[245] Six airship disasters from 1920–1939 were American, or occurred on American soil, and claimed 202 lives.[246] Specifically, the ZR-2/R38 (1921), the *ROMA* (1922), the *Shenandoah* (1925), the *Akron* (1933), the *Macon* (1935), and Germany's *Hindenburg* (1937).[247] The first pre-recorded radio program to be broadcast coast-to-coast in the United States was of the *Hindenburg* disaster at Lakehurst.[248]

Conversely, heavier-than-air accidents did not draw the same level of attention and did not have the same psychological impact on society.[249] In 1929, BuAer logged 287 heavier-than-air crashes with 31 fatalities and 71 injured.[250] In 1932, the year before the *Akron* crashed, BuAer logged 458 heavier-than-air crashes resulting in 22 deaths and 36 injured.[251] In 1936, there were 21 commercial heavier-than-air accidents in the United States resulting in 98 reported fatalities.[252] CDR Rosendahl, writing in defense of the rigid airship in 1938, indicated that the only reason heavier-than-air fatalities had not reached the same level, and attracted the same attention, was "simply that no airplane has yet been able to carry

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243 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 12.

244 Ibid.

245 Ibid.

246 These are not necessarily the eight "spectacularly publicized" international crashes that Duggan and Meyer mention but do not identify. However, these crashes were all spectacularly publicized in America. Arpee, *From Frigates to Flat-Tops*, 232–33; Robinson, *Giants in the Sky*, 330–43; Smith, *The Airships Akron & Macon*, 3.

247 Robinson, *Giants in the Sky*, 330–43; Smith, *The Airships Akron & Macon*, 3.

248 James R. Beniger, *The Control Revolution: Technological and Economic Origins of the Information Society* (Cambridge: Harvard University Press, 1986), 363.

249 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 1–18; Rosendahl, *What About the Airship*?, 140.

250 Moffett, "Annual Report of the Chief of the Bureau of Aeronautics (1929)," 9.

251 "Annual Report of the Chief of the Bureau of Aeronautics (1932)," 493.

252 According to Rosendahl's calculations "as reported in Eastern U.S. Newspapers." Rosendahl, *What About the Airship?*, 138.

as many persons as have the airships that have crashed."[253] Nevertheless, the American public and elected officials came to view the rigid airships as "expensive death-trap[s]"[254] and "ghastly monuments to a stiff-necked, incredibly stubborn Navy Department."[255] In the end, the small numbers and allure of the rigid airship only heightened the spectacle and psychological trauma of their loss.[256] The majority of politicians, businessmen, and senior military officers were no longer willing to be associated with them by 1939.[257] After the losses of the 1930s, with few exceptions, American society had collectively transformed the rigid airship into a lasting stereotype for failure and disaster.[258]

Ultimately, these socio-cultural factors contributed to the termination of the Navy's rigid airship program. The failure to interpret the fleet-type airship's role correctly, at an early stage, undermined the program's usefulness in the eyes of the Fleet.[259] The immense institutional and organizational pressures on lighter-than-air personnel to perform contributed to risk-tolerant behavior and terminal accidents.[260] Lastly, the cumulative impact of airship accidents on the public consciousness, furthered by the mass media of the 1930s, was so severe that rigid airships became synonymous with disaster.[261] What began in the 1900s as the "dream of millennia" had ended.[262] American political and military leaders were no longer willing to endorse the costs and perceived risks associated with rigid airship development.

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253 Ibid., 139.

254 Robinson and Keller, *"Up Ship!,"* 115.

255 Smith, *The Airships Akron & Macon*, 155.

256 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 1–18.

257 Some held on to the rigid airship concept for decades. Edwin J. Kirschner, *The Zeppelin in the Atomic Age* (Urbana: University of Illinois Press, 1957); Litchfield and Allen, *Why? Why Has America No Rigid Airships*; Rosendahl, *What About the Airship?*

258 Arpee, *From Frigates to Flat-Tops*, 232–33; Smith, *The Airships Akron & Macon*, 177.

259 Kline and Pinch, "The Social Construction of Technology," 113–15; Smith, *The Airships Akron & Macon*, 173.

260 Arpee, *From Frigates to Flat-Tops*, 235.

261 Arpee, *From Frigates to Flat-Tops*, 232–33; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 1–18, 231–33; Smith, *The Airships Akron & Macon*, 171–78.

262 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 31.

F. SYNTHESIS AND CONCLUSION

From 1929–1939 the Navy's rigid airship program had its last chance to prove its military utility in the ZRS-4 (*Akron*) and ZRS-5 (*Macon*). However, unlike previous stages of rigid airship development in the United States, all dynamics seemed to turn against the program in the final years of its innovation cycle. First, President Franklin D. Roosevelt personally intervened to ensure the program's termination and he made the executive decision to steer the United States towards heavier-than-air expansion as the threat of war in Europe increased.[263] Second, the inter-service rivalry over coast defense that had sustained the Navy's rigid airship program in the mid-1920s transformed into a competition over long-range heavier-than-air bombers in the 1930s, rendering the continuation of the program unnecessary.[264] Third, the Navy's intra-service dynamics resisting rigid airship development intensified into the 1930s as the carrier-based theory of victory gained wider acceptance and the airships repeatedly failed to demonstrate their worth to the Fleet.[265] Lastly, socio-cultural dynamics compounded and fatally undermined the program. Due to divergent views, lighter-than-air personnel failed to operationalize the potential of the airplane-carrying rigid airship until it was too late.[266] Furthermore, organizational and institutional pressures compelled lighter-than-air officers to accept greater levels of risk in their efforts to demonstrate the value of the rigid airship to the Fleet, resulting in disaster.[267] Lastly, the aggregation of airship disasters by the 1930s, widely sensationalized by the mass media, finally turned the rigid airship into an enduring symbol of failure.[268] The Navy's rigid airship program, accordingly, ended as the United States began its preparations for war and leaders and society put their faith in the airplane.

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[263] Meyer, *Airshipmen Businessmen and Politics*, 241–42.

[264] Smith, *The Airships Akron & Macon*, 9–13.

[265] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 92; Meyer, *Airshipmen Businessmen and Politics*, 241; Robinson and Keller, *"Up Ship!,"* 194.

[266] Smith, *The Airships Akron & Macon*, 173–75.

[267] Arpee, *From Frigates to Flat-Tops*, 235.

[268] Arpee, *From Frigates to Flat-Tops*, 232–33; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 1–18; Smith, *The Airships Akron & Macon*, 171–78; Robinson and Keller, *"Up Ship!,"* 194.

V. CONCLUSION AND IMPLICATIONS

I am not alarmed for either the Navy or the airship; both will survive.

—Commander C. E. Rosendahl
What About the Airship? (1938)[1]

A. THE MULTIPLE DYNAMICS OF MILITARY INNOVATION

The U.S. Navy's rigid airship program existed in physical and conceptual form for over two decades. In the end, 105 men of the U.S. Navy, including Admiral William A. Moffett, and four of the Navy's five rigid airships were lost in the effort.[2] Why did the Navy pursue rigid-type airships for so long in spite of their repeated failures? What influences began and then ultimately ended rigid airship development in the U.S. Navy? This study answers these questions by analyzing the program, and its influences, through the four core paradigms of military innovation from 1900–1939. The objective of this research was to determine which paradigm, if any, could explain what primarily caused the program's initiation, sustainment, and termination.

Examination of the empirical evidence, however, demonstrates that no single paradigm, civil-military,[3] inter-service,[4] intra-service,[5] or socio-cultural,[6] adequately explains why the U.S. Navy maintained a rigid airship program for so long. Some dynamics were more impactful in different phases of rigid airship development, but all paradigms are apparent, in some form or degree of intensity, throughout the entirety of the period examined. Fundamentally, the forces of military innovation driving the program evolved with technological, international, political, economic, and institutional conditions. When

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[1] Rosendahl, *What About the Airship*?, 366.

[2] Robinson and Keller, *"Up Ship!,"* xiii.

[3] Posen, *Sources of Military Doctrine*.

[4] Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*.

[5] Rosen, *Winning the Next War*.

[6] Adamsky, *Culture of Military Innovation*; Farrell and Terriff, "Sources of Military Change"; Goldman, "Spread of Western Military Models."

the forces of innovation aligned in the program's favor, it progressed. When they shifted against the rigid airship, it ended. In the end, the same dynamics that were critical to the rigid airship program's inception and initiation led to its termination. The clearest understanding of the sources of military innovation, in the case of the Navy's rigid airship program, comes through the synthesis of the different military innovation paradigms rather than considering them independently.[7]

In addition, the different civil-military, inter-service, intra-service, and socio-cultural dynamics of military innovation did not exist in isolation and displayed high levels of interaction and interdependence. Civilian political leadership, responding to changing domestic and international conditions, intervened in military policy fueling competition for missions, roles, and resources.[8] Conversely, the inter-service rivalry between the War and Navy Departments influenced civil-military relations, intra-service dynamics, and organizational culture.[9] As Admiral Moffett slowly developed and integrated naval aviation, senior leader support for a theory of victory that included the rigid airship slowly turned into resistance.[10] Alternative innovations, namely the aircraft carrier and heavier-than-air aviation, evolved and matured more rapidly.[11] The supporters of the heavier-than-air theory of victory proliferated, gained seniority, and then used that seniority to undermine the rigid airship program.[12] As the program developed, various social groups and forces played a role in its development. These social interactions, and interpretations of the rigid airship's use, shaped the technology, sustained it, and then eventually led to its

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[7] This is the same conclusion reached by Allison and Zelikow in their study of the different models of foreign policy decision-making (i.e., the combination of models is better than one). Allison and Zelikow, *Essence of Decision*, 389–92.

[8] Bacevich, *The Pentomic Era: The U.S. Army between Korea and Vietnam*; Posen, *Sources of Military Doctrine*; Rosen, *Winning the Next War*.

[9] Arpee, From Frigates to Flat-Tops, 88–121; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 187–188; Hurley, *Billy Mitchell*; Trimble, *Admiral W. A. Moffett*.

[10] Grissom, "The Future of Military Innovation Studies," 913–14, 20; Rosen, *Winning the Next War*, 20.

[11] Robinson and Keller, "*Up Ship!*," 194–195.

[12] Rosen, *Winning the Next War*, 76–105; Rosendahl, *What About the Airship*?, 363–67; Smith, *The Airships Akron & Macon*, 171–73.

termination.[13] However, the rigid airship also shaped society.[14] In the end, the program and its failures led to deep and lasting stereotypes that influenced how politicians and society negatively viewed rigid airships.[15] Ultimately, this thesis provides evidence that the competing paradigms of military innovation do in fact appear to be compatible.[16]

The following sections review, in more detail, the different military innovation paradigms, how their dynamics evolved over time, and how they influenced the Navy's rigid airship program from 1900–1939. The final section concludes with a brief discussion of this work's potential contributions to the future of military innovation studies and the airship.

1. H1: Civil-Military Dynamics

According to this paradigm, civilian policy-makers, identifying changes in the international system, intervene in military doctrine to ensure state survival and subsequently stimulate military innovation.[17] Civilian intervention played a limited role in initiating the rigid airship program, but was critical in its sustainment and eventual termination. Despite limited attempts on behalf of Congress to encourage naval aviation from 1900–1919, these attempts could not overcome the internal bureaucratic resistance of the Navy Department.[18] More pronounced and effective civilian interventions in the 1920s, particularly from the executive branch, made conditions favorable for airship development. Both Presidents, Harding and Coolidge, directly intervened to sustain the program largely

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[13] Grissom, "The Future of Military Innovation Studies," 926–27; Kline and Pinch, "The Social Construction of Technology," 113–15; Pinch and Bijker, "Social Construction of Facts and Artifacts."

[14] Kline and Pinch mention that explaining this dynamic relationship, the simultaneous impact that technological innovation also has on society, is a weakness of SCOT. Kline and Pinch, "The Social Construction of Technology," 113–15.

[15] Arpee, *From Frigates to Flat-Tops*, 232–233; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 1–18; Robinson and Keller, "*Up Ship!*," 193–95; Smith, *The Airships Akron & Macon*, 171–78.

[16] Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," 218.

[17] Grissom, "The Future of Military Innovation Studies," 908–10; Posen, *Sources of Military Doctrine*, 233–34.

[18] Turnbull and Lord, *History of U.S. Naval Aviation*, 1–175.

due to the influence of commercial rather than military interests.[19] These direct presidential interventions allowed the program to continue into the 1930s. Furthermore, civilian interventions in the form of international arms limitation agreements at the Washington Conference (1921–1922) and the London Conference (1930) restricted the Navy's means for accomplishing its military aims in the Pacific.[20] This led to what seemed to be a critical role for the rigid airship in the Navy's war plans.[21]

However, after the crashes of *Akron* (1933) and *Macon* (1935), and the rapid destabilization of global order in the late 1930s, politicians quickly turned against the rigid airship.[22] President Franklin D. Roosevelt directly intervened to promote heavier-than-air expansion in both the Navy and War Departments as the United States drifted towards war in the late 1930s.[23] Simultaneously, President Roosevelt decisively intervened to terminate the Navy's rigid airship program.[24] The civil-military relations hypothesis appears valid, namely, in demonstrating that civilian policy makers, did perceive changes in the international environment, and did intervene in military doctrine to ensure state survival.[25] In this case, the interventions changed over time, along with leader perceptions, and went from encouraging rigid airship technological and doctrinal innovation to terminating it.

2. H2: Inter-Service Dynamics

This hypothesis argues that "resource scarcity is the key catalyst for innovation" in so far as it engenders competition between military services for missions, roles, and service

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19 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 78–79; Robinson and Keller, "*Up Ship!*," 119–21; Smith, *The Airships Akron & Macon*, 9–13.

20 Dingman, *Power in the Pacific*; Fanning, *Peace and Disarmament*; Sprout, *Toward a New Order of Sea Power*.

21 Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 73–74, 92; Miller, *War Plan Orange*, 177; Robinson, *Giants in the Sky*, 182; Robinson and Keller, "*Up Ship!*," 182; Smith, *The Airships Akron & Macon*, 11.

22 Meyer, *Airshipmen Businessmen and Politics*, 241–42; Smith, *The Airships Akron & Macon*, 147–70.

23 Greer, *Air Doctrine*, 100–01; Turnbull and Lord, *History of U.S. Naval Aviation*, 284–317; Meyer, *Airshipmen Businessmen and Politics*, 241–42; Smith, *The Airships Akron & Macon*, 163–70.

24 Smith, *The Airships Akron & Macon*, 163–70.

25 Posen, *Sources of Military Doctrine*, 233–34.

survival.[26] Services compete for dominant capabilities to assume control of "contested mission areas" as part of this rivalry.[27] The validity of this hypothesis is readily apparent in the study of the U.S. Navy's rigid airship program. Inter-service dynamics, specifically the competition between the War and Navy Departments over coast defense and the rigid airship, contributed directly to initiating, sustaining, and terminating the program. Perceived threats from the U.S. Army Air Service, and General Billy Mitchell in particular, provided major incentives for the Navy Department to initiate and then jealously protect the Navy's monopoly on rigid airship development.[28] These threat perceptions emerged immediately following World War I with the Army Air Service's persistent attempts to acquire rigid airships, and continued into the 1920s with the continued advocacy of Billy Mitchell for airships and an independent air force.[29] This rivalry, enflamed by the budget austerity of the 1920s and 1930s, led the Navy to create its Bureau of Aeronautics (BuAer) and contributed to the Navy Department's use of its rigid airships for publicity purposes.[30] Importantly, the threat of the U.S. Army assuming control of the rigid airship program, and the implications that could have for other Navy programs and missions, played a decisive role in the Navy's decision to continue airship development after the *Shenandoah* crash and "LTA Crisis of 1925–1926."[31]

In the 1930s however, after Mitchell's court-martial, the Army Air Corps shifted focus away from airships and towards long-range bombers as its best means of extending its operational reach, and thereby, its missions and funding.[32] The Navy Department

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[26] Grissom, "The Future of Military Innovation Studies," 910–13.

[27] Ibid., 910–11.

[28] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 71–72; Hurley, *Billy Mitchell*, 44–45, 77–78, 80, 84–85, 130–31; Robinson, *Giants in the Sky*, 186–88; Robinson and Keller, *"Up Ship!,"* 117–18; Smith, *The Airships Akron & Macon*, 9–13.

[29] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 70–72; Hurley, *Billy Mitchell*, 44–45, 77–78, 80, 84–85, 130–31; Trimble, *Admiral W. A. Moffett*, 8–13, 141–66; Turnbull and Lord, *History of U.S. Naval Aviation*, 176–92.

[30] Arpee, *From Frigates to Flat-Tops*, 88–112; Davis, *The Admirals Lobby*, 77–79; Trimble, *Admiral W. A. Moffett*, 13–14; Turnbull and Lord, *History of U.S. Naval Aviation*, 186–92.

[31] Lighter-than-air (LTA). Smith, *The Airships Akron & Macon*, 9–13.

[32] Baer, *One Hundred Years of Sea Power*, 123; Greer, *Air Doctrine*, 47; Wildenberg, *Billy Mitchell's War with the Navy*, 169.

responded by developing its own long-range reconnaissance and bombardment capabilities with the heavier-than-air PBY Catalina.[33] By 1935–1936, the nature of the inter-service competition for resources and missions had evolved to the point that there was no longer any risk of the Army seeking rigid airships. The Army Air Corps had the B-17, and no desire to develop or employ airships in its pursuit of coast defense or strategic bombardment missions.[34] Therefore, there was no longer an inter-service reason, or "political feature," compelling the Navy's sustainment of rigid airship development.[35] The inter-service paradigm also provides a compelling explanation for what initiated, sustained, and then ultimately ended, the Navy's rigid airships.

3. H3: Intra-Service Dynamics

This hypothesis focuses on the competition, or "ideological struggle," within the Navy Department and BuAer over new "theories of victory" as the driver of the rigid airship program.[36] This study finds that the Navy's intra-service dynamics were essential in initiating the program in 1919. Senior officers, like Admirals Fiske, Sims, and Dewey, envisioned the rigid airship playing a vital reconnaissance role in support of the future Fleet.[37] However, in the 1920s and 1930s, with the advancement of heavier-than-air officers and the growing acceptance of the aircraft carrier, resistance to the rigid airship intensified.[38] BuAer and the Navy Department divided over the issue of lighter-than-air development, with the majority of officers adhering to a belief in heavier-than-air's superiority.[39] As the number of senior naval officers supporting rigid airships diminished

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[33] Miller, *War Plan Orange*, 178–79.

[34] Greer, *Air Doctrine*, 46–47; Sears Jr., *Helium: The Disappearing Element*, 112; Wildenberg, *Billy Mitchell's War with the Navy*, 169.

[35] Smith, *The Airships Akron & Macon*, 13.

[36] Grissom, "The Future of Military Innovation Studies," 913.

[37] Arpee, *From Frigates to Flat-Tops*, 187–91; Rosendahl, *What About the Airship*?, 342; Smith, *The Airships Akron & Macon*, xxi; Turnbull and Lord, *History of U.S. Naval Aviation*, 28–153

[38] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 187–97; Rosendahl, *What About the Airship*?, 363–67; Smith, *The Airships Akron & Macon*, 163–78.

[39] Arpee, *From Frigates to Flat-Tops*, 232; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 187–88; Smith, *The Airships Akron & Macon*, 163–78.

over time, the supporters of heavier-than-air only gained in numbers and seniority.[40] The lighter-than-air minority, originally elevated in rank and status above heavier-than-air, became increasingly marginalized.[41] After Moffett's death in 1933, senior officer advocacy for rigid airships diminished considerably.[42] In contrast to the aircraft carrier and heavier-than-air, rigid airships lost significant opportunities to integrate with the Fleet from 1925–1931.[43] Ultimately the aircraft carrier and heavier-than-air reached the fleet first and in greater numbers.

By the 1930s, with the arrival of the Navy Department's ultimate airships, the aerial aircraft carriers *Akron* and *Macon*, Navy doctrine was already converging around the proven capabilities of the aircraft carrier.[44] The rigid airship, finally in a form that could be useful to the Fleet, arrived too late and in the face of severe institutional resistance.[45] This institutional resistance led to artificial and biased evaluations of the *Akron* and *Macon* leading to terminal judgments for the airships even before their crashes.[46] After their loss, the Navy was unwilling to resume rigid airship development despite the recommendations of civilian experts, the General Board, and some in BuAer like Admiral Ernest J. King.[47] By the late 1930s, the aircraft carrier dominated naval aviation, and heavier-than-air advocates were in full control of the branch, procurement, and its "promotion pathways."[48]

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[40] Arpee, *From Frigates to Flat-Tops*, 232; Robinson and Keller, *"Up Ship!,"* 8; Rosen, *Winning the Next War*, 76–105; Smith, *The Airships Akron & Macon*, 171–73.

[41] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 187–88; Rosendahl, *What About the Airship*?, 363–67; Smith, *The Airships Akron & Macon*, 171–73.

[42] Smith, *The Airships Akron & Macon*, 173; Trimble, *Admiral W. A. Moffett*; Turnbull and Lord, *History of U.S. Naval Aviation.*

[43] Robinson and Keller, *"Up Ship!,"* 168, 194.

[44] Rosen, *Winning the Next War*, 20–21; Robinson and Keller, *"Up Ship!,"* 194; Smith, *The Airships Akron & Macon*, 171.

[45] Robinson and Keller, *"Up Ship!,"* 194–195; Smith, *The Airships Akron & Macon*, 107–26; 71–78.

[46] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 187–88; Smith, *The Airships Akron & Macon*, 175.

[47] Rosendahl, *What About the Airship*?, 373–77; Smith, *The Airships Akron & Macon*, 163–78.

[48] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 187–88; Grissom, "The Future of Military Innovation Studies," 914; Rosen, *Winning the Next War*, 76–105; Smith, *The Airships Akron & Macon*.

Admiral Moffett once reportedly said about naval aviation, "Hell, we won't secede from the Navy. If we are half as good as we think we are, we'll take it over."[49] Moffett's efforts towards this end over 12 years as Chief of BuAer accomplished a "generational change," an ideological infiltration, which integrated naval aviation with the Fleet and secured its place within the Navy Department.[50] However, as a by-product of Moffett's success, the dominance of heavier-than-air personnel, in numbers, seniority, and through their demonstrated capabilities undermined and ultimately ended the Navy's rigid airship program.[51] Due to intra-service dynamics, which were compellingly apparent in this study, there was no place for rigid airships in the Navy's theory of victory as it began its expansion and preparations for war in the latter half of the 1930s.[52] In the end, the intra-service paradigm seems best to explain resistance to an innovation that represented a significant departure from what was becoming an accepted view of naval aviation. The paradigm is valid, and in explaining Moffett's success of furthering naval aviation, it simultaneously explains the rigid airship's demise.

4. H4: Socio-Cultural Dynamics

The socio-cultural hypothesis posited that organizational or strategic culture played a critical role in perpetuating the Navy's rigid airship program.[53] Additionally, this hypothesis examined the possibility that various social groups could have culturally interpreted rigid airship technology in various ways leading to its eventual form, function, and end state.[54] This hypothesis appears valid in explaining not only why the U.S. Navy

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[49] Arpee, *From Frigates to Flat-Tops*, 114.

[50] Rosen, *Winning the Next War*, 80.

[51] Arpee, *From Frigates to Flat-Tops*, 232; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 92, 187–97; Robinson and Keller, "*Up Ship!*," 194–95; Rosendahl, *What About the Airship*?, 363–67; Smith, *The Airships Akron & Macon*, 171–78.

[52] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 187–97; Robinson and Keller, "*Up Ship!*," 194.

[53] Adamsky, *Culture of Military Innovation*; Farrell and Terriff, "Sources of Military Change"; Grissom, "The Future of Military Innovation Studies."

[54] Farrell and Terriff, "Sources of Military Change," 13–14; Grissom, "The Future of Military Innovation Studies," 926–27; Kline and Pinch, "The Social Construction of Technology," 113–15; Pinch and Bijker, "Social Construction of Facts and Artifacts," 21–34, 40.

initiated a rigid airship program, but also how culture sustained the program after its initial failures, and ultimately contributed to its termination. The program initiated out of a desire to emulate what were perceived as prestigious naval models, namely those of Great Britain and Germany, after the end of World War I.[55] The American Navy, a symbol of national prestige, adopted high-potential technologies utilized by other great powers in an effort to elevate its status, and legitimacy, within the international system.[56] In light of the uncertain strategic and technological environment in 1919, the U.S. Navy chose to emulate Great Britain, its pacing competitor, through pursuing rigid airships and aircraft carriers.[57]

However, after program initiation, social groups, organizational culture, and strategic culture assumed control. In the 1920s, social groups interpreted the technology in divergent ways leading to the exclusive use of helium in airships to enhance public perceptions of safety and to encourage commercial development.[58] After the crashes of the *Shenandoah* and ZR-2 (R38), the Navy's organizational culture and American strategic culture led to policymaker perceptions that the losses were pioneering sacrifices in a vital national effort compelling program continuation.[59]

In the 1930s, organizational cultures and competing sub-groups began to steer the program, both purposefully and inadvertently, towards termination. Social groups within the lighter-than-air community interpreted the rigid airship differently, leading to divergent tactical and doctrinal development.[60] Initial interpretations, focused on utilizing the airplane-carrying rigid airship in a direct-observation role, led to its operational failures and discredit in exercises with the Fleet.[61] Simultaneously, institutional pressures and condescension within the Navy Department influenced airship commanders, increased

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[55] Goldman, "Spread of Western Military Models," 41–67; Robinson and Keller, "*Up Ship!*," 194–95.

[56] Booth, *Navies and Foreign Policy*, 50–84; Goldman, "Spread of Western Military Models," 41–67.

[57] Goldman, "Spread of Western Military Models," 41–67; Robinson and Keller, "*Up Ship!*," 194–95.

[58] Althoff, *Sky Ships*, 27–28; Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 90–91; Kline and Pinch, "The Social Construction of Technology," 113–15; Robinson and Keller, "*Up Ship!*," 61.

[59] Arpee, *From Frigates to Flat-Tops*, 200, 208, 214; Rosendahl, *Up Ship!*, 94–98; Trimble, *Admiral W. A. Moffett*, 95.

[60] Smith, *The Airships Akron & Macon*, 63–75, 127–46.

[61] Ibid., 107–26, 171–78.

their risk-tolerance, and pushed them towards terminal accidents and errors in their efforts to prove the airship's worth.[62] The *Akron* and *Macon* crashes combined with other airship disasters in the 1930s, along with high levels of media attention, and created enduring public stereotypes of the airship as a dangerous failure.[63]

As a result, senior political, military, and industrial decision-makers turned decisively away from the rigid airship and towards heavier-than-air aviation.[64] In sum, organizational and strategic cultural hypotheses appear capable of explaining the program's initiation, sustainment, and termination. In comparison, the social construction of rigid airship technology seems best to explain how culture contributed to rigid airship development, and other non-cultural hypotheses, rather than providing any independently causal explanations.[65]

B. MILITARY INNOVATION STUDIES: MOVING FORWARD

This study offers opportunities and incentives for further research and for enhancing the study of military innovation. Ultimately, this thesis validates assertions about the complimentary nature of existing military innovation paradigms.[66] However, this is not necessarily a fatal flaw. Rather than forcing paradigms to compete for primacy, it might be more beneficial to develop methods of analysis that can synthesize the paradigms. As Allison and Zelikow noted in their study of competing foreign policy decision-making models, "Each … [model] serves as a search engine in the larger effort to identify all the significant causal factors that determine outcome."[67] Furthermore, "by integrating factors identified under each [paradigm], explanations can be significantly enhanced."[68] There is

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[62] Arpee, *From Frigates to Flat-Tops*, 235.

[63] Duggan and Meyer, *Airships in International Affairs, 1890–1940*, 1–18; Robinson and Keller, *"Up Ship!,"* 176, 194–95; Smith, *The Airships Akron & Macon*, 80–82, 92, 155–57, 178.

[64] Meyer, *Airshipmen Businessmen and Politics*, 241–42.

[65] Kline and Pinch, "The Social Construction of Technology"; Pinch and Bijker, "Social Construction of Facts and Artifacts"; Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?"

[66] Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," 202–03.

[67] Allison and Zelikow, *Essence of Decision*, 392.

[68] Ibid.

evidence in this study that a similar situation exists with the paradigms of military innovation. According to Griffin, the successful demonstration of the "genuine mutual compatibility" of the military innovation paradigms has the potential to enhance "the sophistication of our understanding of the relationship between the drivers of innovation."[69] This study has advanced that understanding through demonstrating that comparative analysis, at least in the case of the Navy's rigid airships, clearly illustrates the complex dynamics of military innovation better than any paradigm applied individually.[70]

There are other models available, such as the Tushman-Nadler Congruence Model, that attempt to integrate the various dynamics of innovation into a single model that could support analysis of military innovation as a function of organizational behavior.[71] In the end, the alignment of multiple dynamics, whether in support of or against the rigid airship, seems to have had a more impactful influence on innovation than any dynamic acting alone. The Congruence Model, as its name implies, recognizes the importance of balance between the various internal, external, structural, and even cultural forces that act on an organization and are necessary for innovation to occur and endure.[72] Developed for the commercial sector, Tushman and Nadler's model has the potential to be adapted to the analysis of military innovation even if only to enhance the analysis of military innovation from an organizational behavior perspective.

Additionally, the study of military innovation requires better methods to analyze, or at least to recognize, the symbiotic relationship between failure and success. Typical historical narratives and military innovation studies marginalize the rigid airship or, in extreme cases, view it as "perverse."[73] Potentially, most analysts simply believe that the

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[69] Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," 218.

[70] Confirming in this case Griffin's assertion that comparative analysis might demonstrate the "genuine mutual compatibility" of the paradigms. More comparative studies of different cases and timeframes are necessary to verify whether this remains true outside of the rigid airship scenario. Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," 218.

[71] David Nadler and Michael Tushman, "A Model for Diagnosing Organizational Behavior," *Organizational Dynamics* 9, no. 2 (1980); David Nadler and Michael Tushman, "Organizing for Innovation," *California Management Review* XXVIII, no. 3 (1986).

[72] Ibid.

[73] Till, "Adopting the Aircraft Carrier: The British, American, and Japanese Case Studies," 211.

rigid airship is something better off forgotten. Yet, the Navy's airship efforts contributed to the development of other technologies and innovations that enabled the successful development of aviation.[74] Specifically, the Navy's rigid airship program contributed to: 1) the mass-production of duralumin for all-metal airplanes; 2) helium production for future aerospace efforts; 3) a better understanding of meteorology and reporting of weather data; 4) a greater understanding of aerodynamic stresses and engineering.[75] In addition, the power plant developed for latter rigid airships ultimately became the engine for some of the most notable American fighter aircraft in the Second World War.[76] Lastly, there is the fact that the aircraft carrier originated in England in response to the threat of German rigid airships in World War I.[77] Would carrier aviation and strategic bombing doctrine have developed the same in absence of rigid airships? It is impossible to tell. However, it is certain that the rigid airship did influence other successful military innovations even if only as a perceived competitor.

It would be parochial to limit analysis to examples of "successful" innovation while ignoring the alternatives that competed with and contributed to that success. Similarly, limiting analysis and explanations to only one innovation paradigm appears to be artificially omitting additional useful explanations and enhanced understanding. A method of analysis that integrates, rather than excludes, would seem to be a fruitful area for future development and research. At a minimum, additional studies comparing the explanatory power of the paradigms of military innovation are required to support or refute the "mutual compatibility" demonstrated within this thesis.[78]

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[74] Robinson and Keller, *"Up Ship!,"* xiii; Smith, *The Airships Akron & Macon*, 178.

[75] Ibid.

[76] Smith notes that the V-1710 engine, or its later variants, was used in the P-38, P-39, P-40, and P-51. Smith, *The Airships Akron & Macon*, 178.

[77] Robinson, *The Zeppelin in Combat*, 255; Till, "Adopting the Aircraft Carrier: The British, American, and Japanese Case Studies," 195.

[78] Griffin, "Military Innovation Studies: Multidisciplinary or Lacking Discipline?," 218.

C. AIRSHIPS IN THE 21ST CENTURY?

The purpose of this research was to neither promote nor denigrate the airship. However, with the resurgence of international interest in lighter-than-air vessels, it seems worth concluding with some final general thoughts on the Navy's rigid airship program that might have enduring relevance. Currently companies in the United States, China, Russia, Germany, England, and France are developing airships for military or commercial purposes.[79] While the U.S. Government briefly considered airships for strategic lift in the early 2000s, it is unclear whether the large airship has any future in the American military.[80] The pressure to emulate other powers might eventually compel action, particularly if other states begin to develop commercially or militarily successful airships.[81]

The potential of lighter-than-air transport continues to be alluring.[82] As Smith observed, "As long as air weighs 80 pounds per 1,000 cubic feet and helium 11 pounds for the same quantity, the principle of lighter-than-air aeronautics will remain fundamentally sound."[83] Helium-filled airships continue to have the potential to carry more cargo than aircraft, move it faster than surface vessels, and at significantly reduced costs.[84] They have

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[79] Robert Beckhausen, "Why Russia Dreams of an Arctic Airship Fleet," *The National Interest* (blog), September 10, 2016, https://nationalinterest.org/blog/the-buzz/why-russia-dreams-arctic-airship-fleet-17660; Jeffrey Lin and P.W. Singer, "China Tests Its Largest Airship," Popular Science, October 16, 2015, https://www.popsci.com/china-tests-its-largest-airship; Mark Piesing, "How Airships Could Return to Our Crowded Skies," BBC, November 8, 2019, https://www.bbc.com/future/article/20191107-how-airships-could-return-to-our-crowded-skies; Lei Zhao, "Test in 2020 for Airship That Hauls Cargo, Tourists," Novemberv 28, 2018, Telegraph, https://www.telegraph.co.uk/news/world/china-watch/technology/new-airship/.

[80] Walter O. Gordon and Chuck Holland, "Back to the Future: Airships and the Revolution in Strategic Airlift," *Air Force Journal of Logistics* 29, no. 3 (2005); Zachery B. Jiron, "Hybrid Airships for Lift: A New Paradigm," *Army Sustainment* 44, no. 6 (2012); U.S. Congressional Budget Office, *Options for Strategic Military Transportation Systems* (Washington, DC: The Congress of the United States, 2005), https://www.cbo.gov/sites/default/files/109th-congress-2005-2006/reports/09-27-strategicmobility.pdf.

[81] If one accepts the New Institutionalism premise of institutional isomorphism. Goldman, "Spread of Western Military Models."

[82] An enduring theme of rigid airship history is the gap between potential and performance. Robinson and Keller, *"Up Ship!"*; Smith, *The Airships Akron & Macon*, 44, 171–78.

[83] Smith, *The Airships Akron & Macon*, 177.

[84] Gordon and Holland, "Back to the Future"; Jiron, "Hybrid Airships for Lift: A New Paradigm"; U.S. Congressional Budget Office, *Options for Strategic Military Transportation Systems*.

the potential to supplement commercial transport, can bypass ports and railways, and sustain austere locations lacking transportation infrastructure.[85] Militarily, they could perform a variety of missions ranging from surveillance, to strategic lift, to being carriers of unmanned aerial systems.[86] The appeal of the airship's range, lift, and endurance is undiminished. While these factors remain only potential, they could become reality if the current lighter-than-air models of several companies find gainful employment in the near future and demonstrate their reliability.[87] As Robinson wrote, "The obstacles are not technical, they are psychological and financial."[88]

If the United States does attempt to resurrect large airships for commercial or military purposes, there will be challenges and opportunities. Primarily, any new airship must face deeply ingrained social stereotypes regarding airship vulnerability.[89] Indeed, Smith wrote that, "It may be necessary for the present generation to pass away so the airship can be 're-invented.'"[90] While it has been over fifty years since Smith wrote, developers must remain mindful of the immediate, and potentially terminal, ramifications that will arise if an airship crashes. However, the critical lesson from the Navy's rigid airship program is that proven performance is essential. Promises will carry a program only so far.[91] The only way to dispel public and political misgivings about airships is to put them to work as soon as they are ready to perform. Gaining the support of senior military and civilian decision makers is equally important; otherwise, the airships will never get a

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85 Ibid.

86 Gordon and Holland, "Back to the Future"; Ronald D. Hochstetler et al., *Lighter-Than-Air (LTA) 'Airstation' - Unmanned Aircraft System (UAS) Carrier Concept* (Washington, DC: American Institute of Aeronautics and Astronautics, 2016), https://arc.aiaa.org/doi/10.2514/6.2016-4223; Jiron, "Hybrid Airships for Lift: A New Paradigm."

87 The hybrid airship, which derives lift both aerodynamically and aerostatically, is a commonly considered platform. Gabriel A. Khoury, "Unconventional Designs," in *Airship Technology*, ed. Michael J. Rycroft and Robert F. Stengel (Cambridge: Cambridge University Press, 2004), 392–94; "Hybrid Airship: Revolutionizing Remote Transport," Lockheed Martin Corporation, https://www.lockheedmartin.com/en-us/products/hybrid-airship.html; Hybrid Air Vehicles, "Airlander 50," Hybrid Air Vehicles, https://www.hybridairvehicles.com/aircraft/airlander-50.

88 Robinson, *Giants in the Sky*, 325.

89 Smith, *The Airships Akron & Macon*, 177.

90 Ibid.

91 Ibid., 44, 171–78.

chance to demonstrate their worth. For military purposes, the potential multi-domain applications of the vehicle are apparent. The airship could feasibly support any branch of service. Therefore, a joint development approach is advisable. Otherwise, if history is any indication, narrow service interests might turn against it. Whether manned or unmanned, or used for surveillance, strategic lift, or as an aerial carrier, the airship's various interpretations must align with real capabilities, and requirements, in support of an accepted theory of victory.[92] In the end, the potential of the airship has its best chance of turning into a reality through understanding and unifying the forces behind military innovation. An approach that omits, or ignores, civil-military, inter-service, intra-service, or socio-cultural dynamics is unlikely to succeed.

[92] Kline and Pinch, "The Social Construction of Technology," 113–15; Rosen, *Winning the Next War*, 20–21.

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