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**REMOVED FROM THE COCKPIT:
THE PILOT IDENTITY CRISIS AND THE RISE
OF UNCREWED AIRCRAFT IN NAVAL AVIATION**

by

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In the transition from crewed to uncrewed aircraft, naval aviation has focused on the technical instead of the human aspects of the change. The transition challenges the traditional pilot identity, based on sitting in a cockpit and physically operating an aircraft, because pilots of uncrewed aircraft control them remotely or manage the battlefield rather than the cockpit. This thesis uses identity theory and social identity theory to analyze similar cultural factors in the Navy's transition from sail-to-steam power in the 1800s to identify how and why some line officers resisted and rejected steam technology, inhibiting the transition. In this case study, naval leadership encouraged resistance through orders mandating sail over steam power and failed to direct the needed change in line officer identity when engineers took away propulsion control and replaced the symbols associated with the line officer identity. To avoid repeating this failure, the Navy must oversee the pilot identity transition in order to leverage the full potential of both technology and humans. Instead of creating division, naval leaders should emphasize unity by creating an inclusive pilot identity, using terms that do not focus on human occupants when referring to aircraft categories, and creating viable career paths for all.

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REMOVED FROM THE COCKPIT: THE PILOT IDENTITY CRISIS AND THE RISE OF UNCREWED AIRCRAFT IN NAVAL AVIATION

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ABSTRACT

In the transition from crewed to uncrewed aircraft, naval aviation has focused on the technical instead of the human aspects of the change. The transition challenges the traditional pilot identity, based on sitting in a cockpit and physically operating an aircraft, because pilots of uncrewed aircraft control them remotely or manage the battlefield rather than the cockpit. This thesis uses identity theory and social identity theory to analyze similar cultural factors in the Navy's transition from sail-to-steam power in the 1800s to identify how and why some line officers resisted and rejected steam technology, inhibiting the transition. In this case study, naval leadership encouraged resistance through orders mandating sail over steam power and failed to direct the needed change in line officer identity when engineers took away propulsion control and replaced the symbols associated with the line officer identity. To avoid repeating this failure, the Navy must oversee the pilot identity transition in order to leverage the full potential of both technology and humans. Instead of creating division, naval leaders should emphasize unity by creating an inclusive pilot identity, using terms that do not focus on human occupants when referring to aircraft categories, and creating viable career paths for all.

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I. INTRODUCTION

A. MAJOR RESEARCH QUESTION

This thesis answers the question: How can naval aviation overcome the personnel challenges involved in adopting a hybrid aircraft environment?

B. SIGNIFICANCE OF THE RESEARCH QUESTION

Currently, the transition to a hybrid force of uncrewed, crewed, and autonomous aircraft is focused on the capabilities and technical aspects of each uncrewed system. When the transition documents mention humans, they emphasize how to recruit people who can work with new systems; how to provide technical education to current personnel to work with autonomous, uncrewed, or artificially intelligent systems; and the need to build trust between humans and machines.[1] However, within the service-wide documents detailing the adoption and implementation of uncrewed and autonomous systems, the Navy has overlooked the importance of transitioning humans from the current to a hybrid paradigm. The human transition involves changing naval aviation culture, which is created by the people involved, and altering how those people identify with their job and role in naval aviation. While the navy acknowledges that cultural and doctrinal barriers exist, there is little elaboration about how to overcome them, and there is no mention of a potential identity problem.[2] Therefore, there is little emphasis on either cultivating a cultural change within naval aviation as a whole or specifically within the aviator population.

Cultural issues create a two-fold problem regarding the transition to a hybrid aircraft environment. First, technological change creates an identity issue when that

[1]Department of the Navy, *Department of the Navy Unmanned Campaign Framework* (Washington, DC: Department of the Navy, 2021), 9, https://www.navy.mil/Press-Office/Press-Releases/display-pressreleases/Article/2538616/navy-marine-corps-release-unmanned-campaign-plan/; Department of the Navy, *Department of the Navy Science & Technology Strategy for Intelligent Autonomous Systems* (Washington, DC: Department of the Navy, 2021), 3, https://news.usni.org/2021/07/29/department-of-the-navy-strategy-for-intelligent-autonomous-systems.

[2] Department of the Navy, *Department of the Navy Strategic Roadmap for Unmanned Systems* (Washington, DC: Department of the Navy, 2018), https://www.secnav.navy.mil/rda/Documents/Forms/DispForm.aspx?ID=47; Department of the Navy, *Department of the Navy Unmanned Campaign Framework*, 22.

identity is based around an already established technology. The hybrid model will affect naval aviation culture because the current role of a pilot is defined by physically sitting in and operating an aircraft. The crewed-aircraft tradition is often seen as superior to other types of pilot-machine relationships as evidenced by the difficulty remotely operated aircraft pilots have had in being recognized as pilots versus operators.[3] Having a pilot inside the aircraft is crucial to the system as designed today because the current naval enterprise and aircraft are built around supporting this human-controlled system. Consequently, an entire identity has been created around pilots, especially fighter pilots, reinforced in popular culture by such movies and television shows as *Top Gun* and *JAG.* Elements of flying—for example, dogfighting against an adversary and being able to dance in the sky high above the earth—have taken on mythical qualities. Pilots compare themselves based on their ability to maneuver, control, land, and shoot weapons from their aircraft. Therefore, flying is a large part of their identity. The introduction of uncrewed, and especially autonomous, platforms challenges this identity because the human role changes. Instead of physically flying an aircraft, which is perceived as an elite ability, the pilot is relegated either to remote ground control or riding onboard the aircraft making battlespace decisions while the aircraft intelligence system does the actual flying. Thus, what it means to be a naval aviator will change as pilots move from direct operators of aircraft to detached managers.

Distrust of the new paradigm can result in a second cultural problem: resistance to adopting the latest technology based on distrust in its capabilities or lack of operational expertise.[4] In this case, hybrid and autonomous aircraft within naval aviation is the new paradigm. Historically, both the military and the navy have had problems culturally transitioning personnel during significant technological changes. For instance, switching from sail- to steam-powered vessels represents a major military technical transition. The transition to technologically advanced steam-powered ships and the engineering officers

[3] Ian Wiesner, "A Sociology of the Drone," *Journal of Military and Strategic Studies* 18, no. 1 (October 29, 2018): 55, https://jmss.org/article/view/58280.

[4] William M. McBride, *Technological Change and the United States Navy: 1865-1945* (Baltimore, MD: Johns Hopkins University Press, 2000), 4.

who operated them threatened line officers' identity and social structure, which was based around operating sail-powered vessels.[5] As a result, naval line officers as a group hesitated to adapt and slowed the transition. In this case, a new technology challenged the traditional organizational culture and identity centered around the sail-savvy naval officer.[6] Consequently, the roles of those involved with the old tradition had to be redefined to incorporate the new technology. The sail-to-steam example shows the twin cultural problems of identity defined by the old technology and slowed adoption based on distrust of the new technology's capability. Today, naval aviation faces a similar challenge as the current pilot model is becoming increasingly obsolete in the transition to a hybrid environment.

This thesis analyzes how to encourage and increase change within naval aviation culture to smooth the transition from a mostly crewed fleet to a more hybrid fleet. As the only constant factor in every technological shift, the human element cannot be ignored. This hybrid transition will result in a drastically different human role since humans are moving from intimate system operators to managers of multiple systems, distanced from the mechanical aspects of flight. In the hybrid world, human pilots are imagined to be battlespace managers, tasked with higher cognitive tasks that cannot yet be delegated to machines.[7] Therefore, humans will be responsible for managing, overseeing, and developing uncrewed capabilities. The shift from crewed aircraft to a hybrid environment is an opportunity for naval aviation to learn from past transitions and leverage the full potential of both technology and humans.

C. LITERATURE REVIEW

This literature review explores the relationship between technological changes and individuals through three areas of scholarship: future of work literature, social identity, and

[5] McBride, 8, 13.

[6] McBride, 6; Edward Katzenbach Jr., "The Horse Cavalry in the Twentieth Century: A Policy Response," in *Public Policy: A Yearbook of the Graduate School of Public Administration* (Cambridge, MA: Harvard University Press, 1958), 120.

[7] Ken Plaks, "Air Combat Evolution (ACE)," Defense Advanced Research Projects Agency, accessed August 10, 2021, https://www.darpa.mil/program/air-combat-evolution; "AlphaDogfight Trials Final Event," August 20, 2016, DARPAtv, video, 5:07:15, https://www.youtube.com/watch?v=NzdhIA2S35w.

organizational transitions. Each topic is framed around its applicability for analyzing the interaction between naval aviators and current technological changes, since this thesis studies how to transition naval aviators from a crewed to hybrid aircraft environment.

1. Future of Work

Because scholars agree that human jobs are being replaced by machine labor and automation, the main debate in the future-of-work literature centers on the outcome of labor automation. One school of thought argues that as routine physical tasks are taken over by machines, humans will be able to specialize in inherently human skills that complement automated jobs, resulting in an increase in human labor.[8] Conversely, a second set of scholars argues that most human jobs will be automated, freeing humans to pursue non-economic activities.[9]

While automation takes over certain skill sets, not every task is capable of being automated. Renowned economist, David Autor, argues that human jobs can be separated into routine and repetitive tasks that can be easily automated and tasks that require emotion, interpersonal interaction, and problem-solving that are better done by humans.[10] He uses the example of quadrupling ATMs in the early 2000s and the simultaneous rise in bank teller employment to illustrate how automating routine bank teller tasks increased the value of human bank tellers as salespeople.[11] Both Autor and Brynjolfsson argue that if humans

[8] David H. Autor, "Why Are There Still So Many Jobs? The History and Future of Workplace Automation," *The Journal of Economic Perspectives* 29, no. 3 (2015): 3–30, https://www.jstor.org/stable/43550118; Erik Brynjolfsson, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies*, 1st ed. (New York, NY: W.W. Norton & Company, 2014); Erik Brynjolfsson and Tom Mitchell, "What Can Machine Learning Do? Workforce Implications," *Science* 358, no. 6370 (December 22, 2017): 1530–34, https://doi.org/10.1126/science.aap8062.

[9] Joel Mokyr, Chris Vickers, and Nicolas L. Ziebarth, "The History of Technological Anxiety and the Future of Economic Growth: Is This Time Different?," *The Journal of Economic Perspectives* 29, no. 3 (2015): 31–50.*The Journal of Economic Perspectives* 29, no. 3 (2015): 31–50, http://www.jstor.org/stable/43550119; John Maynard Keynes, "Economic Possibilities for Our Grandchildren," in *Economic Possibilities for Our Grandchildren* (New York, NY: W.W.Norton & Company, 1963), 358–373, http://www.econ.yale.edu//smith/econ116a/keynes1.pdf; Daniel Susskind, *A World Without Work: Technology, Automation, and How We Should Respond* (New York, NY: Metropolitan Books/Henry Holt and Company, 2020).

[10] Autor, "Why Are There Still So Many Jobs?," 5.

[11] Autor, 6.

and machines are tasked with jobs matching their unique capabilities, then human labor increases in value.[12] Humans are innately better at critical thinking, creativity, empathy, and social interactions, while machines are better at quantitative transactions, computing large amounts of data, repetitive actions, and manual labor.[13] So, transferring repetitive, quantitative tasks to machines allows humans to focus on socially based skills and higher-level thinking. Brynjolfsson, however, takes the argument one step further by saying that technology is not a threat but an opportunity for humans to transform the future if machines are treated as teammates instead of adversaries.[14] Overall, this school of thought contends that human labor is not disappearing, but merely evolving toward skills machines cannot yet replicate.

However, a second set of scholars argues that automation will increasingly displace human labor until very few humans will have to work. Keynes and Susskind argue that increased machine labor will increase economic output and profit, resulting in economic prosperity and freedom from economic dependence.[15] Similarly, Mokyr uses the Industrial Revolution as an example study to predict a future decrease in human labor as machines replicate human cognitive abilities, similar to how the mechanization of manual labor in the 19th and 20th centuries moved humans away from manual labor.[16] These scholars, exemplified by Susskind and Keynes, put forward a two-step argument to explain this phenomenon. First, humans will be "forced to retreat to an ever-shrinking set of activities" as machine labor increases.[17] Then, the ensuing wealth from increased production is predicted to create overall economic prosperity, raise standards of living, and free humans to "focus on being alive and aiming for personal perfection."[18]

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[12] Autor, 5; Brynjolfsson and McAfee, *The Second Machine Age*, 182.

[13] Brynjolfsson and McAfee, 182.

[14] Brynjolfsson and McAfee, 9.

[15] Keynes, "Economic Possibilities for Our Grandchildren," 3–5; Susskind, *A World Without Work*, 238.

[16] Mokyr, Vickers, and Ziebarth, "The History of Technological Anxiety and the Future of Economic Growth," 35, 42.

[17] Susskind, *A World Without Work*, 3.

[18] Susskind, 238; Keynes, "Economic Possibilities for Our Grandchildren," 3–5.

Another aspect of the change created by increased machine labor is how people identify with their work. Keynes and Susskind mainly focus on how the complete disappearance of work affects identity because humans are defined by working for a living.[19] To support the connection between work and identity, Susskind uses the significance of occupation-based questions in introductory conversations at dinner parties to argue that work has an "important social dimension" that gives people a chance "to gain social status and social esteem."[20] Keynes spends less time analyzing identity impacts, but acknowledges that humans will need to find a new purpose in life as work decreases.[21] Within this discussion, there is little analysis about how change in work type, instead of its complete disappearance, can affect how workers identify with their work. This thesis analyzes how a change in job description, such as pilots switching from being intimate operators of aircraft to managers of multiple aircraft systems removed from flying the actual aircraft, impacts a worker's identity. Pilots will still be needed, but what it means to be a pilot will change. Based on the future of work literature, there is a connection between identity changes created by complete loss of work and changes in required skill set and role.

2. Social Identity

The foundation for facilitating human transitions is based in social identity research within psychology and sociology. Since William James, the Father of American Psychology, coined the phrase "social self" in the late 1800s, scholars have explored the relationship between identity and society, resulting in two recent theories: identity theory and social identity theory.[22] Exemplifying this scholarly movement, Stets and Burke created identity theory, relating to the sociology of occupations, which emphasized the

[19] Susskind, *A World Without Work*, 218, 238; Keynes, "Economic Possibilities for Our Grandchildren," 4–5.

[20] Susskind, *A World Without Work*, 218.

[21] Keynes, "Economic Possibilities for Our Grandchildren," 5.

[22] William James, *The Principles of Psychology*, 2nd ed., Great Books of the Western World 53 (Chicago, IL: Encyclopedia Britannica, Inc, 1990), 189.

influence of roles people hold within society on identity.[23] A second set of scholars headed by Turner and Tajfel, developed social identity theory to explain how group membership influences a person's self-concept, through internalization of group values, behavior, and norms, creating an ingroup versus outgroup mentality.[24] Even more recently, in the digital era, technoself studies have been established to study the relationship between humans and technology, under the base assumption that humans and technology influence each other in many areas, including identity.[25]

Pilots fulfill a specific role that identity theory predicts affects their identity. Before identity theory was established, sociologists, such as Berger and Zurcher, explored a similar concept of occupational influence on identity. Through a series of occupational case studies, Berger argued that people shaped "an occupational self-image consistent with the demands of the work situation or of the occupation as a whole" by creating a narrative to give meaning to their work.[26] Though Berger considered "role" an inferior term compared to "calling," role has become increasingly important in sociology.[27] For example, Zurcher emphasized the importance of role expectations and meanings through his research on a

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[23] Jan E. Stets and Peter J. Burke, "Identity Theory and Social Identity Theory," *Social Psychology Quarterly* 63, no. 3 (2000): 224–37, https://doi.org/10.2307/2695870; Peter Burke and Jane Stets, *Identity Theory* (New York, NY: Oxford University Press, 2009); Louis A. Zurcher, *Social Roles: Conformity, Conflict, and Creativity*, Sociological Observations 15 (Beverly Hills, CA: SAGE Publications, 1983); Peter Berger, *The Human Shape of Work: Studies in the Sociology of Occupations* (New York, NY: MacMillan, 1964).

[24] Dominic Abrams, "Affective and Cognitive Implications of a Group Becoming Part of the Self: New Models of Prejudice and of the Self-Concept," in *Social Identity and Social Cognition* (Malden, MA: Blackwell, 1999), 189–93; Eliot Smith, "Social Identity, Social Cognition, and the Self: The Flexibility and Stability of Self-Categorization," in *Social Identity and Social Cognition* (Malden, MA: Blackwell, 1999), 200–22; "Social Identity Theory," Learning Theories, 2020, https://www.learning-theories.com/social-identity-theory-tajfel-turner.html.

[25] Erica Orange, "Understanding the Human Machine Interface in a Time of Change," in *Handbook of Research on Technoself Identity in a Technological Society* (Hershey, PA: Information Science Reference, 2013), 703–719; Rocci Luppicini, "The Emerging Field of Technoself Studies," in *Handbook of Research on Technoself Identity in a Technological Society* (Hershey, PA: Information Science Reference, 2013), 1–25; Nick Bostrom and Anders Sandberg, "The Future of Identity" (London, UK: UK Government Office for Science, 2011); Robert Dunn, "Identity Theories and Technology," in *Handbook of Research on Technoself Identity in a Technological Society* (Hershey, PA: Information Science Reference, 2013), 26–44.

[26] Berger, *The Human Shape of Work*, 228, 234–35.

[27] Berger, 215.

variety of role relationships, in groups ranging from airline passengers and crew members to members of the naval reserve.[28]

Zurcher's work directly connects to identity theory; identity theory describes "categorization of the self as an occupant of a role, and the incorporation, into the self, of the meanings and expectations associated with that role and its performance."[29] People use self-verification to determine if their self-concept matches the identity and meanings attached to roles they take on.[30] Consequently, a person can have more than one role, such as mother, sister, teammate, mentor, and cook with different related meanings, expectations, and identity impacts. Interactions with other people are based on negotiating and working within assumed roles.[31] Though identity theory emphasizes role enactment and differences between roles and social identity theory emphasizes group membership and similarities between members, both theories rely on the interaction between society and people. Humans create society, give meanings to various relationships, roles, and groups, and then act within that world.[32]

In naval aviation, "pilot" refers not only to a unique individual identity but also to a group identity within the Navy. Through social identity theory, Tajfel and Turner argue that part of the individual concept of self comes from the value and significance given to group memberships.[33] Once part of a group, members share the norms, values, characteristics, and behaviors specific to the group through social identification. As a person connects emotionally with the group, they see themself as "an embodiment of the in-group prototype," which prompts differentiation between the group they are a part of, the ingroup, and other groups called outgroups.[34] Additionally, other scholars have argued

[28] Zurcher, *Social Roles*, 11, 14–15.

[29] Stets and Burke, "Identity Theory and Social Identity Theory," 225.

[30] Stets and Burke, 232.

[31] Burke and Stets, *Identity Theory*, 12.

[32] Burke and Stets, 3–4.

[33] Dominic Abrams and Michael A. Hogg, *Social Identity and Social Cognition* (Malden, MA: Blackwell, 1999), 2.

[34] Stets and Burke, "Identity Theory and Social Identity Theory," 231.

that first-impression stereotypes are based on the outside viewer's perception of particular group membership.[35] The outside viewer uses the stereotype to guide judgment and behavior.[36] Based on analysis of past studies on individuals and self-concept, Eliot Smith took the emotional connection to a group a step further by concluding that, as group members, people "respond emotionally and behaviorally not to events or situations that impinge on the personal self, but also to intergroup situations."[37] Smith argued further that prejudice and discrimination result from strong emotional connections to a group versus another group.[38] Overall, social identity theory relates to this thesis because naval aviation is a group with many smaller groups, including those of naval aviators. Exploring the effect of pilot and aviation membership on identity is crucial for using the organizational adoption and transition models, which are applied to the current transition to determine how to reduce aviator resistance.[39]

Technoself studies was established to explore this intersection between humans, society, and identity in the technology context of the late 1990s. Technoself describes "the evolving configurations of human-technological relationships that continually shape the human condition and what it means to be a human being."[40] In this field, Luppicini argues that human meaning and identity are shaped and challenged by technology, especially in the digital age through advancements like virtual reality, avatars, and human-enhancements.[41] Furthermore, Dunn claims recent technology influences identity through role-playing options, communication changes, creating conflict between desire for anonymity and instant fame, and differentiating virtual and real identities."[42] Erica Orange

[35] Abrams, "Affective and Cognitive Implications of a Group Becoming Part of the Self: New Models of Prejudice and of the Self-Concept," 222.

[36] Abrams, 222.

[37] Smith, "Social Identity, Social Cognition, and the Self: The Flexibility and Stability of Self-Categorization," 193.

[38] Smith, 193.

[39] The organizational models are introduced in Section C.3 of this chapter.

[40] Luppicini, "The Emerging Field of Technoself Studies," 3.

[41] Luppicini, 2–3.

[42] Dunn, "Identity Theories and Technology," 38.

takes the argument a few steps further, by claiming that human identity is threatened by the shrinking gap between machines and humans because the roles are reversing.[43] She argues that human identity will become more fluid, intangible, and unstable because traditional identity metrics like income and demographics fade in the face of digitalization; tools like big data control human perceptions and behavior, and virtual reality allows identity reinvention.[44] Though this thesis is not focused on the purely digital realm, the technoself lens is relevant for understanding how the change from crewed to uncrewed or autonomous aircraft could impact pilot identity. Similarly, a hybrid environment implies a change in the interaction between humans and technology.

3. Technological Transitions in Organizations

The literature on managing technological transitions within organizations consists of three main perspectives revolving around what or who should be the focal point of the transition. The first perspective emphasizes the organization as a whole, and reframing business practices and capabilities to adopt new technology successfully.[45] The second perspective introduces the concept of organizational culture, a combination of people and practices, as the "key to how organizations function" and vital to implementing new technology.[46] Combining old and new technology through inventor, technology, and hybrid bridges within an organization is one proposed method for overcoming the gap

[43] Erica Orange, "Understanding the Human Machine Interface in a Time of Change," in *Handbook of Research on Technoself Identity in a Technological Society* (Hershey, PA: Information Science Reference, 2013), 703, 717.

[44] Orange, 712, 716.

[45] Clayton M. Christensen, *The Innovator's Dilemma*, 3rd ed. (Boston, MA: Harvard Business Review Press, 2016); Clayton M. Christensen and Michael Overdorf, "Meeting the Challenge of Disruptive Change," *Harvard Business Review* 78, no. 2 (2001): 103–29, http://libproxy.nps.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=2839608&site=ehost-live&scope=site.

[46] Edgar H. Schein, "Culture: The Missing Concept in Organization Studies," *Administrative Science Quarterly* 41, no. 2 (1996): 229–40, https://doi.org/10.2307/2393715; S.D. Noam Cook and Dvora Yanow, "Culture and Organizational Learning," *Journal of Management Inquiry* 20, no. 4 (December 1, 2011): 362–79, https://doi.org/10.1177/1056492611432809; Edgar H. Schein, *Organizational Culture and Leadership*, 3rd ed. (San Francisco, CA: Jossey-Bass, 2004).

between the two technologies.[47] The last set of scholars argues that successful transitions require psychologically changing the people within an organization and molding the technology to fit user expectations.[48]

Disruptive technology—which is completely new and built neither on current products nor on services offered by an organization—challenges traditional business practices.[49] Consequently, Christensen argues that disruptive technology creates an intrinsic conflict for the organization because the new technology does not fit the current business model, seems irrational, or will not turn an immediate profit.[50] Similarly, in an article with Michael Overdorf, Christensen claims that technology change is unrelated to people in established organizations because the organization's values and processes define the ability to change.[51] Christensen proposes five recommendations for implementing new technology: building a new and independent business around the new technology, matching the size of the organization and new technology size; assuming market trend forecasts are wrong; knowing and understanding the organization processes and values; and realizing that initial supply of the new technology will overshoot demand.[52] Therefore, according to this perspective, successful transitions require changes in the organization itself, distinct from the people involved. Overlooking the human element is a fundamental weakness of this model because history is full of examples of human resistance inhibiting the adoption of new technology. Consequently, this organizational perspective is outside the scope of this paper because this thesis focuses on changing individuals, not the Navy

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[47] S. Thomke, "Enlightened Experimentation: The New Imperative for Innovation," *Harvard Business Review* 79, no. 2 (2001): 179–205, http://libproxy.nps.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=4390363&site=ehost-live&scope=site; Schein, *Organizational Culture and Leadership*; William Bridges, *Managing Transitions: Making the Most of Change*, 2nd ed. (Cambridge, MA: Perseus, 2003).

[48] Everett M. Rogers, *Diffusion of Innovations*, 5th ed. (New York, NY: Simon and Schuster, 2003); Mary Tripsas, "Technology, Identity, and Inertia Through the Lens of 'The Digital Photography Company,'" *Organization Science* 20, no. 2 (April 1, 2009): 441–60, https://doi.org/10.1287/orsc.1080.0419; Bridges, *Managing Transitions*.

[49] Christensen, *The Innovator's Dilemma*, xvi.

[50] Christensen, 228.

[51] Christensen and Overdorf, "Meeting the Challenge of Disruptive Change," 103.

[52] Christensen and Overdorf, 117; Christensen, *The Innovator's Dilemma*, xxiii.

as an entire organization. Furthermore, the Navy has already implemented uncrewed aircraft within naval aviation, indicating that the organization, broadly speaking, has adopted a new business model.

However, the second perspective, advanced by Edgar Schein, is more relevant to this thesis because it argues that molding the interaction between an organization and the people within it, labeled as organizational culture, is essential for adopting new technology. Schein defines organizational culture as "shared norms, values, and assumptions" held by people within an organization that define how they perceive, think, and feel as well as the ability of the group to cope and learn.[53] Based on this definition, Schein claims that proposed change can create resistance if it violates some part of the organization's cultural identity.[54] Another study by Yanow and Cook combined Schein's concept of organizational culture with organizational learning in an analysis of technological change in three flute companies and determined that successful implementation required merging the innovation with the organizational identity.[55] While Yanow and Cook's recommendations for change focused on group attributes, Schein's recommendations focused more on individuals, including training, practice with the new technology, support groups, role models, and unlearning.[56]

Schein's claim that technological change "requires a period of unlearning" for individuals within an organization has been challenged by recent research on incorporating old knowledge in new technology.[57] In a longitudinal study of fourteen photography firms, Cohen and Tripsas explored three bridges to connect the gap between old and new technology: inventor bridges, which used the old inventors to develop the new technology; technology bridges, where new inventions built off old knowledge; and hybrid bridges that

[53] Schein, "Culture," 229; Schein, *Organizational Culture and Leadership*, 17.

[54] Schein, *Organizational Culture and Leadership*, 321.

[55] Cook and Yanow, "Culture and Organizational Learning," 360, 364.

[56] *Organizational Culture and Leadership*, 332–335.

[57] Schein, 335.

created products with old and new technology.[58] They concluded that technology and hybrid bridges increased inventive performance in the new technology area, supporting the idea that old technology "can serve as a stepping stone to help organizations move between generations."[59] Other scholars have explored the complementary nature of old and new knowledge in the research and development process, arguing that technology adoption is influenced by how much the new technology relates to the pre-existing knowledge base of the organization and the targeted users.[60] Though the use of old knowledge is still widely debated by scholars, the combination of old and new technology and information directly applies to the adoption of uncrewed and autonomous aircraft within naval aviation because the transition involves all three types of bridges. For example, using operators of the older technology, crewed aircraft, to operate and analyze the new aircraft is a modified inventor bridge, while creating a crewed aircraft that operates primarily through artificial intelligence is a hybrid bridge.

The third set of scholars also recognizes the importance of old knowledge because they claim that understanding how the change from old to new impacts individuals within an organization is key to a successful transition. William Bridges took the human-focus concept several steps further by developing a three-stage process to move people through a technological transition that challenged their identity by "getting people to stop doing things the old way and getting them to start doing things a new way."[61] To Bridges, the change, not the new technology, was the problem because the change threatens the world people are accustomed to.[62] In a longitudinal study of a digital photography company, Tripsas came to a similar conclusion that an organization must recognize whether or not a

[58] Susan L. Cohen and Mary Tripsas, "Managing Technological Transitions by Building Bridges," *Academy of Management Journal* 61, no. 6 (December 1, 2018): 2320, https://doi.org/10.5465/amj.2015.0690.

[59] Cohen and Tripsas, 2336–37.

[60] Thomke, "Enlightened Experimentation: The New Imperative for Innovation," 193–194; Wesley M. Cohen and Daniel A. Levinthal, "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly* 35, no. 1 (1990): 148, https://doi.org/10.2307/2393553.

[61] Bridges, *Managing Transitions*, xi.

[62] Bridges, 137.

new technology will challenge the identity of the organization and the people within it, and if so, would need to implement a process to change the current identity.[63]

While Bridges focused on personal internalization of the changes brought about by the new technology, Everett Rogers focused on the spread of innovation as "a universal process of social change."[64] He developed an innovation process based on the interaction between the innovation, people in the applicable social system, and the communication channels between those people based on the argument that innovation is successful only if adopted by the people using it.[65] Furthermore, he outlined five metrics to compare the new technology with the old technology and user characteristics to determine the likelihood of successful adoption: relative advantage, compatibility, complexity, trialability, and observability.[66] Though these models are based on changing culture and identity within traditional businesses instead of military organizations, they may be generalizable to the military. Since this thesis studies how to transition naval aviation and naval aviators from the old, crewed paradigm to a new hybrid paradigm, Bridges's and Rogers's models will be used to analyze past technological transitions within the military and evaluate how change could be encouraged within naval aviation as the hybrid aircraft environment is implemented.

In conclusion, research on the future of work, social identity, and organizational change and culture is essential for this thesis. At the broadest level, the future of work literature explores the consequences of major technological transitions revolving around the division of labor between humans and machines and introduces the interconnection between humans, work, and meaning. Next, social identity research reveals the deep interconnections between identity, society, and technology where individual identity and cultural resistance originates. Lastly, organizational culture and transition literature focus on adopting new technology within individual organizations, such as the Navy and

[63] Tripsas, "Technology, Identity, and Inertia Through the Lens of 'The Digital Photography Company,'" 454–55.

[64] Bridges, *Managing Transitions*, 4–5; Rogers, *Diffusion of Innovations*, xvi.

[65] Rogers, *Diffusion of Innovations*, 36–38.

[66] Rogers, 265–66.

naval aviation. Organizational researchers Everett Rogers and William Bridges have created models for decreasing resistance to and increasing adoption rates of new technology within organization employees. Together, these three elements create a framework to analyze human resistance to past military technological transitions and provide potential recommendations to reduce resistance in the current transition from crewed to hybrid aircraft.

D. RESEARCH DESIGN

This science and technology studies thesis uses qualitative methods to explore the interaction between technology, science, and society.[67] Specifically, this thesis studies the challenges of adaptation and potential obsolescence of the traditional identity associated with being a naval aviator in the new hybrid environment containing crewed, uncrewed, and autonomous aircraft. One case study of a past technological transitions in the Navy is analyzed to spotlight patterns of human resistance, based on identity and cultural implications, to technological transitions. The transition from sail-powered to steam-powered vessels is a classic study of cultural resistance within the Navy because the implementation of steam-powered vessels challenged the identity and expertise of naval officers raised in the sail tradition.

In both the sail-to-steam and crewed-to-uncrewed aircraft case studies, relevant identity factors are explored through identity theory and social identity theory to explain the development of individual and group resistance. Identity theory focuses on people's roles within society. People often have multiple roles based on location and relationships that are triggered by contextual clues.[68] Each role carries certain meanings and behavioral expectations, and by occupying a role, an individual incorporates those expectations and

[67] For more information on Science and Technology Studies see: President and Fellows of Harvard College, "What Is STS?," Harvard University, accessed November 24, 2021, https://sts.hks.harvard.edu/about/whatissts.html.

[68] Jan E. Stets and Peter J. Burke, "Identity Theory and Social Identity Theory," *Social Psychology Quarterly* 63, no. 3 (2000): 226, https://doi.org/10.2307/2695870; Peter Burke and Jane Stets, *Identity Theory* (New York, NY: Oxford University Press, 2009); Louis A. Zurcher, *Social Roles: Conformity, Conflict, and Creativity*, Sociological Observations 15 (Beverly Hills, CA: Sage Publications, 1983).

meanings into their self-identity.[69] Basically, people's roles become part of their individual identity. Moreover, an individual differentiates themselves from others based on their respective roles.

While identity theory focuses on individual roles, social identity theory looks at group membership and the creation of out-groups and in-groups. Once part of a group, individuals embody the group identity by incorporating group values, behaviors, and norms into their individual behavior and identity.[70] Group members attain power and status from the group identity and begin to view nonmembers as outsiders.[71] Consequently, the interaction between group membership and identity affects intergroup relations by creating out-groups and in-groups. Together, these two theories show how the self and society interact in the creation of identity.

After analyzing the identity factors, each case study is evaluated through William Bridges' human-focused model for organizational implementation of new technology and Everett Rogers' innovation model to highlight where in the broader organizational transition resistance occurred and how to minimize resistance in the future. Lessons learned from the sail-to-steam case study are applied to the current naval aviation transition to help facilitate a quicker transition and bring about the benefits of the new technology faster.

William Bridges' created a three-phase transition model to evaluate individual identity-based resistance to organizational change.[72] To help organizations minimize resistance and transition people through changes, he proposed a model with three overlapping phases: letting go, the neutral zone, and the new beginning.[73] The letting go

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[69] Stets and Burke, "Identity Theory and Social Identity Theory."

[70] Stets and Burke, 225; Henry Tajfel, ed., *Social Identity and Intergroup Relations* (Cambridge, UK: Cambridge University Press, 1982); Dominic Abrams and Michael A. Hogg, *Social Identity and Social Cognition* (Malden, MA: Blackwell, 1999); Michael Billig, *Social Psychology and Intergroup Relations* (London, UK: Academic Press, 1976), http://archive.org/details/socialpsychology0000bill; J. C. Turner, R. J. Brown, and H. Tajfel, "Social Comparison and Group Interest in Ingroup Favouritism," *European Journal of Social Psychology* 9, no. 2 (1979): 187–204, https://doi.org/10.1002/ejsp.2420090207.

[71] Stets and Burke, "Identity Theory and Social Identity Theory," 225.

[72] William Bridges, *Managing Transitions: Making the Most of Change*, 2nd ed. (Cambridge, MA: Perseus, 2003), 5.

[73] Bridges, 5.

phase includes acknowledging the loss of the old identity, letting go of the old identity and associated habits, and potentially discarding associated roles.[74] The neutral zone includes repatterning identity and learning the new technology because the old identity and technology are gone and the new ones are not fully operational.[75] Lastly, the new beginning focuses on the creation of the new identity and meanings associated with the new technology.[76]

While Bridges' model focuses on the individual psychological level, Everett Rogers' five-step diffusion of innovation model looks at the effect of the broader social process within an organization on implementing new technology.[77] For an innovation to be used, it must be adopted by those who are supposed to use it.[78] Rogers' model centers on the interaction between the innovation, people in the affected social system, and the communication channels between those people.[79] The first two stages, agenda-setting and matching, are called the initiation phase because they occur before the decision is made to adopt a new innovation.[80] In agenda-setting, an organization identifies problems that require innovation, and then matches problems with specific innovations in the matching stage.[81] The second phase, after the decision is made, includes the redefining, clarifying, and routinizing stages.[82] In the redefining stage, an organization's leaders are supposed to modify the innovation to match the organization's needs and structure.[83] Clarifying includes widespread use of the innovation while educating the organization's members on

[74] Bridges, 4.

[75] Bridges, 5.

[76] Bridges, 5.

[77] Everett M. Rogers, *Diffusion of Innovations*, 5th ed. (New York, NY: Simon and Schuster, 2003).

[78] Rogers, 177.

[79] Rogers, *Diffusion of Innovations*, 36.

[80] Rogers, 421.

[81] Rogers, 422-24.

[82] Rogers, 421.

[83] Rogers, 424-27.

the technology's meaning and purpose.[84] Lastly, routinizing occurs once the new technology is standardized within the organization.[85]

According to Rogers, rejection can occur at any stage within the model.[86] He separated rejection into three types: active, passive, and discontinuance.[87] He defines active rejection as considering the adoption of an innovation and then deciding not to use it while passive rejection is deciding not to adopt after "never really considering the use of the innovation.[88] Discontinuance is rejection after adopting an innovation.[89]

Roger argues that adoption depends on the characteristics of those choosing whether to adopt a new technology and the characteristics of the new compared to the old technology. Rogers categorizes people into five adopter categories based on how quickly they adopt the new technology: innovators, early adopters, early majority, late majority, and laggards.[90] Innovators often introduce new ideas and technology while laggards are "the last in a social system to adopt an innovation," and the other three groups are in between.[91]

He also identified five innovation characteristics, that affect the adoption rate when compared to the old technology: relative advantage, compatibility, complexity, trialability, and observability.[92] Relative advantage is how much the new technology is perceived to be better than the old.[93] While compatibility is how well the new technology matches current values, past experience, and needs of those adopting it, complexity is how difficult

[84] Rogers, 427-28.

[85] Rogers, 428-29.

[86] Rogers, 177.

[87] Rogers, 178, 190.

[88] Rogers, *Diffusion of Innovations*, 178.

[89] Rogers, 190.

[90] Rogers declares these categories to be ideal types so, in reality, people may fit into more than one category. Not all characteristics of his categories may apply to a situation. Rogers, *Diffusion of Innovations*, 281.

[91] Rogers, 282-284.

[92] Rogers, *Diffusion of Innovations*, 216, 265–66.

[93] Rogers, 265.

it is to operate, use, and understand.[94] The more compatible and less complex an innovation is, the more likely it will be adopted.[95] Trialability is how much an innovation can be tested by the users before adoption and observability is how visible the change in technology is to the users.[96] Higher trialability and observability increase adoption rates.[97]

E. THESIS OVERVIEW

Chapter I introduces the research question and the problem to be addressed. It also builds a framework by establishing current research on social identity theories, future of work studies, and approaches to technological change within organizations. From the framework comes the main lenses to view the case studies: identity theory, social identity theory, Rogers' three phase transition model, and Bridges' five-step innovation in organizations model. Chapter II lays out the history, current state, and predicted future of uncrewed aircraft within naval aviation to establish two patterns. First, uncrewed aircraft development has intertwined with crewed aircraft development since their inception in the late 19th and early 20th centuries. Second, the Navy has a cyclical pattern of interest in uncrewed aircraft that favors crewed aircraft. Chapters III explores how engineers as steam engine operators challenged the traditional line officer identity rooted in sail power through identity theory and social identity theory. Chapter IV furthers the sail-to-steam analysis by placing the identity-based resistance within the context of the broader organizational transition through Bridges' and Rogers' organizational models. Chapter V explores the identity and cultural factors involved in the current transition from crewed to uncrewed aircraft that could trigger resistance to uncrewed aircraft and aerial vehicle operators. Lastly, Chapter VI summarizes the lessons learned and conclusions from the case studies about the pattern of human resistance to technological transitions within the military, provides recommendations on how to minimize resistance in the current transition, outlines limitations of this study, and proposes future research possibilities.

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[94] Rogers, *Diffusion of Innovations*, 240, 257.

[95] Rogers, 240, 257.

[96] Rogers, 266.

[97] Rogers, 266.

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II. UNCREWED AIRCRAFT IN NAVAL AVIATION: PAST, PRESENT, AND FUTURE

This chapter establishes the fluctuating history and evolving role of uncrewed aircraft within naval aviation. In the past, uncrewed aircraft have been used for many tasks, including target practice, target illumination, collecting intelligence, and crashing into targets. Today, in naval aviation, uncrewed aircraft are used to assist crewed aircraft and vessels through limited missions like intelligence, surveillance, reconnaissance and targeting (ISR&T). Uncrewed platforms of all types, as stated by the Chief of Naval Operations in the 2021 Navigation Plan, "play a vital role in our future fleet."[98] Within naval aviation, according to the 2030–2035 Naval Aviation Vision, the uncrewed aircraft mission set is imagined to expand to fill more "diverse roles in the future air wing…in missions such as refueling, communications relay, logistics, [and] airborne electronic attack."[99] In other words, in the march toward increased reliance on autonomous and uncrewed systems, the naval service intends to keep and refine the current hybrid force model while increasing the number of uncrewed aircraft into the projected future.

This chapter also discusses relevant interactions between uncrewed and crewed aircraft and their operators to highlight both how the role of uncrewed aircraft has changed and the significance of the current power transition from crewed to uncrewed aircraft. In the past, uncrewed aircraft have always played a secondary and complementary role to crewed aircraft. Occasionally uncrewed research and operational aircraft have been canceled in favor of crewed aircraft development because the crewed aircraft model was perceived as superior by high-level Navy officials. Uncrewed aircraft histories focus on technology's evolution and overshadow the reactions and perceptions of the pilots involved. However, digging deeper reveals how pilot and high-level naval officer

[98] M.M. Gilday, *CNO NAVPLAN* (Washington, DC: Department of the Navy, 2021), 11, https://www.navy.mil/Press-Office/Press-Releases/display-pressreleases/Article/2467465/cno-releases-navigation-plan-2021/.

[99] NAVAIR, *Navy Aviation Vision 2030-2035* (San Diego, CA: NAVAIR, 2021), 6, https://cle.nps.edu/access/content/attachment/efbadfbf-d9ba-43a0-b9c0-9fc0bea50a21/Announcements/c17edc67-e4f1-4a9f-92d2-b3a5696fb5df/2021%20Dist%20A%20NAE%20Vision%202030-2035%20Oct%202021.pdf.

perceptions of and reactions to uncrewed aircraft frequently impacted development and implementation of uncrewed aircraft within naval aviation. Current Navy planning documents describe a future where uncrewed aircraft fulfill an increasing range of missions and are a peer and potentially dominant partner with crewed aircraft that represents a cultural change that raises questions about pilot identity and culture.[100]

A. PAST

Uncrewed aircraft were used in combat before crewed aircraft. The Austrians used one of the earliest renditions of uncrewed aircraft in 1849 to attack Venice.[101] They loaded balloons with explosives and attached a copper trailing wire for remote detonation**.** Because control automation had not yet been developed, the Austrians relied on the wind to push the balloons toward Venice and away from Austrian territory and personnel.

At the turn of the century, control automation development reduced the risk and unpredictability associated with uncrewed aircraft by introducing remote human control over the flight path. Control automation was originally developed for crewed aircraft to reduce the physical effort required to move flight controls through trim and autopilot. However, by reducing and potentially eliminating the need for pilot input inside the cockpit, automation increased the potential for uncrewed aircraft development.

In the first decade of the 1900s, Elmer Sperry created the gyroscope to stabilize aircraft movement without operator inputs.[102] Thus, the gyro, when attached to the aircraft

[100] See the previously mentioned *2020 CNO NAVPLAN*, *2030-2035 Navy Aviation Vision*, and the *Department of the Navy 2021 Unmanned Campaign Framework*. Chapter III will focus on identity-related issues while Chapter IV will focus on culture-related issues.

[101] Keep in mind the term "aircraft" is used loosely here. In the 1800s and even until the mid-1900s many types of aerial device capable of movement fit under the definition of aircraft including the Austrian balloons, missiles, and the models discussed later in this chapter. H. R. Everett, *Unmanned Systems of World Wars I and II* (Cambridge, MA: MIT Press, 2015), 247; The term "unmanned aircraft" has become more restrictive in the military and excludes balloons and missiles. In 2005, unmanned aerial vehicle was defined as "a powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload, Ballistic or semiballistic vehicles, cruise missiles, and artillery projectiles are not considered unmanned aerial vehicles." See Joint Chiefs of Staff, *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1–02 (Washington, DC, 2005), 563, https://www.bits.de/NRANEU/others/jp-doctrine/jp1_02%2805%29.pdf.

[102] Dave Sloggett, *Drone Warfare: The Development of Unmanned Aerial Conflict* (South Yorkshire, UK: Pen & Sword Books Ltd, 2014), 14.

controls, could bring the aircraft back to stable flight after inputs were made or disturbances from weather impacted the aircraft. With this invention, in 1909 Sperry was the first to combine automatic stabilization, remote control, and autonomous navigation in an aircraft to create an aircraft able to sustain flight without direct pilot control.[103] The stage was set for military development of uncrewed aircraft.

However, Sperry's first prototype was turned down by both the Army and Navy because it did not live up to their expectations. The Army lost interest after the prototype crashed several times.[104] Sperry reinstalled his automated controls and gyroscope system in a Curtiss seaplane for Navy Lieutenant Patrick Bellinger to test. Despite successful test flights, the Navy decided not to support the uncrewed aircraft program because "it was no substitute for an experienced pilot."[105]

Yet, a few years later, in 1915, the Navy invested in Sperry and uncrewed aircraft for the first time once Sperry pitched an idea for an uncrewed aerial torpedo. For the Navy, Sperry developed a flying bomb as an aerial version of a guided torpedo, in collaboration with Glenn Curtiss, a founder of the American aviation industry (see Figure 1).[106] Takeoffs and landings were controlled by a ground operator or an operator located in another aircraft, but control could be handed off to the autopilot once in the air.[107] However, operator control was limited to line-of-sight.

[103] Laurence R. Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles* (Reston, VA: American Institute of Aeronautics and Astronautics, Inc., 2004), 16.

[104] Newcome, 16.

[105] Newcome, 16.

[106] Everett, *Unmanned Systems of World Wars I and II*, 248.

[107] Everett, 249.

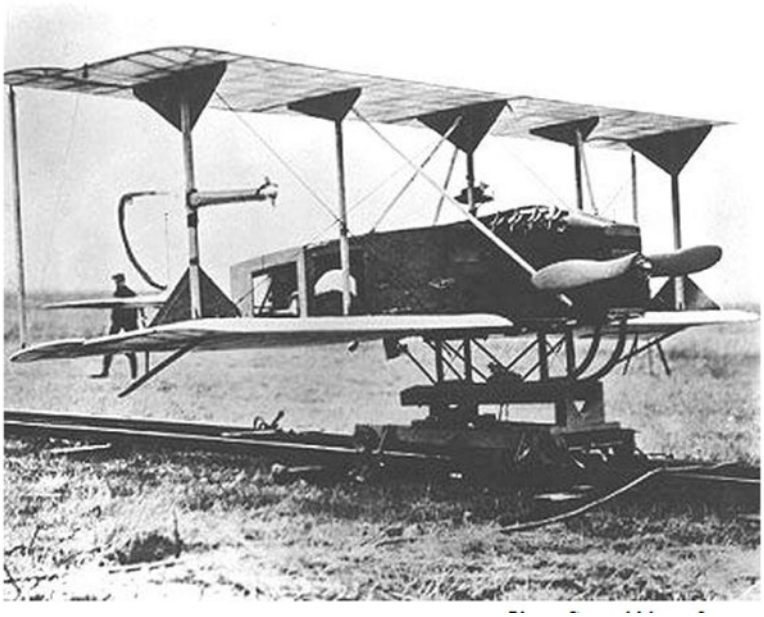

Figure 1. Sperry Flying Bomb[108]

The flying bomb illustrates the beginning of the pendulumlike relationship between the Navy and uncrewed aircraft. LT Wilkinson, from the Navy's Bureau of Ordnance, attended the September 1916 test flight to determine whether the Navy could use the flying bomb.[109] Though the flying bomb's automatic control feature successfully worked, Wilkinson determined "the prototype had enough potential for further pursuit, albeit insufficient accuracy for maneuvering naval targets."[110] Wilkinson further believed that the "concept might be more applicable to the Army for strategic attacks," where static objects rather than maneuvering ships would be the intended targets.[111] Consequently, the Navy terminated the program in favor of ship-launched aircraft capable of carrying bombs.[112]

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[108] Source: Andreas Parsch, "Sperry 'Flying Bomb,'" Designation-Systems, last modified May 12, 2005, http://www.designation-systems.net/dusrm/app4/sperry-fb.html.

[109] Everett, *Unmanned Systems of World Wars I and II*, 248.

[110] Erik Haywood Stoer, "Flying Bombs, Aerial Torpedoes, and Kettering Bugs: America's First Cruise Missiles," (master's thesis, Florida State University, 2001), 18, ProQuest (UMI 3021532).

[111] Everett, *Unmanned Systems of World Wars I and II*, 249.

[112] Everett, 251.

To encourage the development of uncrewed bombers with autopilot, the Navy, with the recommendation of the Naval Consulting Board, funded and equipped Sperry's research into aircraft autopilots.[113] In May 1917 the Navy gave Sperry $200,000 and five N-9 Curtiss seaplane trainers for experimentation.[114] In September 1917, Sperry's autopilot-controlled N-9 dropped imitation bombs within two miles of the designated target at a range of thirty miles (Figure 2).[115] The next month, the Navy ordered six more aircraft for Sperry to outfit with autopilot.[116] However, the six aircraft were gone after twelve test flights because of autopilot, mechanical, and launch-related failures.[117] Due to the consecutive failures, the Chief of Naval Operations cancelled the program.[118]

Figure 2. N-9 with Autopilot Installed[119]

In 1921, the Secretary of the Navy briefly reinstated research into uncrewed aircraft until more test flight failures called into question the potential of the aircraft.[120] Research done by the Naval Research Lab on remote-control guidance was combined with previous

[113] Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, 18.

[114] Newcome, 18.

[115] Everett, *Unmanned Systems of World Wars I and II*, 251.

[116] Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, 18.

[117] Newcome, 18.

[118] Everett, *Unmanned Systems of World Wars I and II*, 251.

[119] Source: William G. Holder, *Unmanned Air Vehicles: An Illustrated Study of UAVs*, A Schiffer Military History Book (Atglen, PA: Schiffer Publishing, 2001), 289.

[120] Everett, *Unmanned Systems of World Wars I and II*, 288.

autopilot research in several N-9 prototypes.[121] In 1924, one of the modified aircraft successfully flew for forty minutes under both radio-control from the ground and autopilot and demonstrated the ability of an aircraft to take off, maneuver, and land without direct human intervention.[122] The following year, the technology was transferred to a newer Vought-developed airframe. In 1925, the test aircraft sank from command-and-control issues between the aircraft and radio controller on the ground.[123] That same year, the Navy canceled the program because the "slow pace and erratic progress of the effort had drained Navy enthusiasm."[124]

1. Target Drones Back to Assault Aircraft

In 1936, Admiral Standley, the Chief of Naval Operations, revived American naval interest in using uncrewed aircraft as targets after seeing demonstrations of British Queen Bee drones.[125] Standley's desire to create an uncrewed aircraft for naval gunnery target practice culminated in the creation of the TDD, Target Drone Denny, models developed by Radioplane Company under the guidance of Reginald Denny through the 1930s and World War II (see Figure 3).[126] These radio-controlled drones mimicked the movements and defensive measures of current fighter aircraft to provide the most accurate simulations of enemy aircraft for antiaircraft guns.[127]

[121] Everett, 289.

[122] Everett, 289.

[123] Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, 37.

[124] Newcome, 38.

[125] Today unmanned aircraft are commonly called "drones." Both the modern usage of "drone" and the name Target Drone Denny stemmed from the biological connection between queen and drone bees. Since the British aircraft was called the Queen bee, the American version was referred to as a drone. Everett, *Unmanned Systems of World Wars I and II*, 306.

[126] Everett, 300; Sloggett, *Drone Warfare: The Development of Unmanned Aerial Conflict*, 60.

[127] Sloggett, *Drone Warfare: The Development of Unmanned Aerial Conflict*, 59.

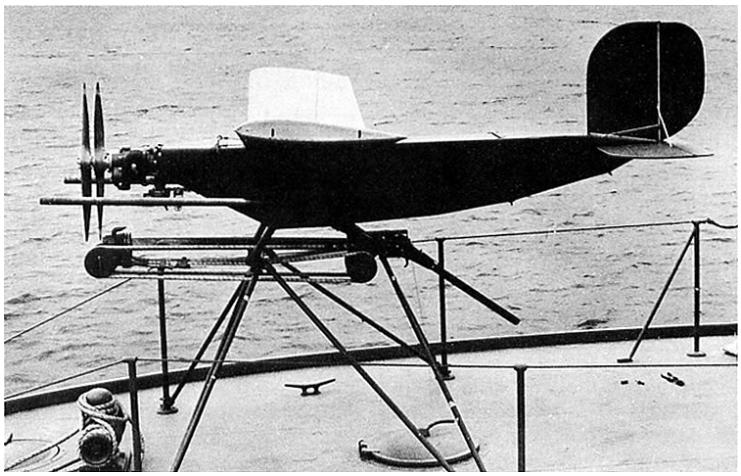

Figure 3. TDD-1 at Sea[128]

After the first exercise using radio-controlled drones as naval gunnery targets in August 1938, Denny's target drones were implemented across the fleet.[129] Drones were issued to cruisers, destroyers, and battleships, such as the USS *Idaho* and USS *Patterson* for gunnery practice.[130] Also, the Navy commissioned Fleet Utility Squadron Three in 1939 to provide drone support for the Atlantic fleet and Fleet Utility Squadron Five in 1941 for the Pacific fleet.[131] By 1941, the target drones were well established within fleet operating procedures and assigned to ships and specially created squadrons around the world.

Subsequently, the idea of using uncrewed aircraft as offensive weapons resurfaced because wide use of the TDD models revealed deficiencies in antiaircraft techniques and equipment. Between the cancellation of the N-9 program in 1925 and 1942, the Navy had focused on developing the target potential of uncrewed aircraft instead of offensive capabilities. However, naval gunners recorded low success rates in shooting down the

[128] Source: Russell Naughton, "Reginald Denny and Walter H. Righter: Radioplane in the Navy," CTIE, last modified July 24, 2005, https://www.ctie.monash.edu.au/hargrave/radioplane_navy.html.

[129] Everett, *Unmanned Systems of World Wars I and II*, 306.

[130] USS *Idaho* (DD-392) and USS *Patterson* (BB-42) Everett, 306–7.

[131] Everett, 307.

highly maneuverable target drones.[132] Inability to hit the drones prompted the Navy to reevaluate the potential for using similar aircraft to carry explosives and evade enemy gunners.

Though the Navy continued to use variations of the TDD for target practice, research and development switched focus from the target capability of uncrewed aircraft to offensive potential. In March 1942, the Navy ordered 200 new uncrewed aircraft in two variants, TDN-1 and TDR-1, with interchangeable guidance systems to use as guided explosives (see figures 4 and 5).[133] The TDR-1 primarily used a television camera to provide feedback for the operator to guide the aircraft to its target while the TDN-1 primarily used radar.[134] Aircraft control was complicated because launch was controlled from an operator located outside and behind the uncrewed aircraft, initial inflight controls were given to the pilot of a chase aircraft, and then final targeting guidance was controlled by the backseat pilot of the chase aircraft using the television or radar feed.[135]

Figure 4. Refurbished TDR-1[136]

[132] For instance, in a series of antiaircraft drills in Guantanamo Bay the USS *Utah* expended 1,500 rounds without shooting down one target drone. In 1940, only ten drones were shot down across the sixty-one antiaircraft drills held across the entire fleet. Everett, 306.

[133] Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, 67.

[134] Everett, *Unmanned Systems of World Wars I and II*, 331.

[135] Everett, 331.

[136] Source: Wikipedia, s.v. "naval aircraft factory TDN," last modified January 20, 2022, https://en.wikipedia.org/w/index.php?title=Naval_Aircraft_Factory_TDN&oldid=1066914945.

Figure 5. TDN-1[137]

In World War II, these models were the first American uncrewed aircraft to be used in combat, setting a precedent for modern uncrewed aircraft. Inspired by the potential of offensive uncrewed aircraft in 1942, Navy staff planners, with the blessing of Fleet Admiral King and Commander Fahrney, wanted to create 18 squadrons with 162 crewed control planes, 1,000 uncrewed aircraft, 10,000 support personnel, and 1,300 pilots to provide offensive uncrewed aircraft capabilities.[138] Over time those numbers were dramatically reduced because Rear Admiral Towers, Chief of the Bureau of Aeronautics, wanted aircraft production focused on conventional crewed aircraft and pilots instead of balanced between crewed and uncrewed aircraft.[139] Though the Navy ended up ordering 200 TDR-1 and TDN-1 aircraft, only 50 were used in combat by the three Special Task Air Group squadrons.[140] The launch of four uncrewed aircraft against Japanese targets near Bougainville on September 27, 1944, marks the first use of an American uncrewed aircraft in combat.[141]

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[137] Source: Wikipedia, s.v. "interstate TDR," last modified January 20, 2022, https://en.wikipedia.org/w/index.php?title=Interstate_TDR&oldid=1066914942.

[138] At the time, Admiral King was the Chief of Naval Operations. Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, 67.

[139] Everett, *Unmanned Systems of World Wars I and II*, 323.

[140] Everett, 323.

[141] Everett, 332.

Despite the success of the aircraft in combat, the program followed the canceled path of prior uncrewed aircraft projects. In the two months of operational use, no pilots were lost, and the aircraft achieved 62% accuracy against a range of targets including vessels, bridges, supply caves, and gun emplacements.[142] In September 1944, the entire program was offered to the Army because the "fledgling standoff capability for small-scale surgical strike" capabilities of the TDR and TDN were no longer needed.[143] After the Army declined, the Navy cancelled the program in October and the remaining aircraft were used for target practice.[144]

2. Reconnaissance and Complementary Missions

In the next stage of development, the role of uncrewed aircraft shifted from one-use targets and guided bombs to multiple-use aircraft capable of providing complementary capabilities to other aircraft and missions. The next prominent uncrewed aircraft used by the Navy, the QH-50 Drone Antisubmarine Helicopter, was created to extend the antisubmarine capability of destroyers (see Figure 6). The QH-50 was not only the first American rotary wing uncrewed aircraft but the first uncrewed aircraft to be take off and return to the vessel under its own power.[145] The earlier TDR and TDN models were one-use only because they crashed into their targets with explosive payloads. Operational in 1963, pairs of QH-50 aircraft deployed on destroyers primarily to extend the range of the ship's torpedoes.[146] Each aircraft could carry two Mk 44 homing torpedoes or a nuclear depth charge to target submarines far away from the ship.[147] As the rotary craft morphed throughout several models, the mission set expanded to include bombing, surveillance,

[142] Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, 69.

[143] Everett, *Unmanned Systems of World Wars I and II*, 339.

[144] One TDR-1 survived and is displayed at the National Naval Aviation Museum in Pensacola, FL. Everett, 339.

[145] Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, 83.

[146] Newcome, 83.

[147] For nuclear depth charge information see: Benjamin Armstrong, "Armaments & Innovations: DASH, Snoopy, and the Night Panther," *Naval History* (Annapolis, United States: United States Naval Institute, June 2016), https://www.usni.org/magazines/naval-history-magazine/2016/june/armaments-innovations-dash-snoopy-and-night-panther.

cargo transfer, and gunfire spotting through the installation of television cameras and a video data link.[148] The versatility and reusability of the QH-50 departed from prior uncrewed models that had limited capabilities and were often one-use only.

Figure 6. QH-50 Above a Destroyer[149]

However, due to lack of support from Navy personnel, the QH-50 program was dropped in 1970 as crewed helicopter antisubmarine capabilities advanced through the Light Airborne Multi-Purpose System. At the time, the concept of the QH-50 "challenged aviators who were focused on flying high and fast in manned jets."[150] Consequently, surface warfare officers, with little to no aviation experience, operated the QH-50 as a collateral duty. There were few experienced QH-50 operators because personnel often only spent a few months operating the helicopter. Between the surface navy operators' inexperience with and naval aviators' disdain for the helicopter, the QH-50 had no base of support when challenged by the development of antisubmarine capabilities in a crewed

[148] Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, 88.

[149] Destroyer is the *USS Allen M. Summer* (DD 692). Source: Wikipedia, s.v. "Gyrodyne QH-50 DASH," last modified November 15, 2021, https://en.wikipedia.org/w/index.php?title=Gyrodyne_QH-50_DASH&oldid=1055323974.

[150] Armstrong, "Armaments & Innovations: DASH, Snoopy, and the Night Panther."

helicopter in the late 1960s.[151] In 1970, Congress stopped funding the program, and military research agencies took the remaining aircraft.[152]

The Model 147SK, the Navy's other short-lived uncrewed aircraft used during the Vietnam War, was created primarily to collect intelligence (see Figure 7). Developed in the late 1960s for multiple military services, including the Navy and Air Force, the Model 147 conducted over 300 missions, primarily photoreconnaissance for intelligence collection.[153] Despite proven collection capability, the Navy did not invest in more Model 147s after the initial inventory was gone.[154] Despite their short life spans, both of these aircraft show a change in the Navy's usage of uncrewed aircraft from one-use aircraft that required many personnel to control to multiple-use aircraft capable of complementing and assisting other missions through capabilities like intelligence collection and extension of ship defenses.

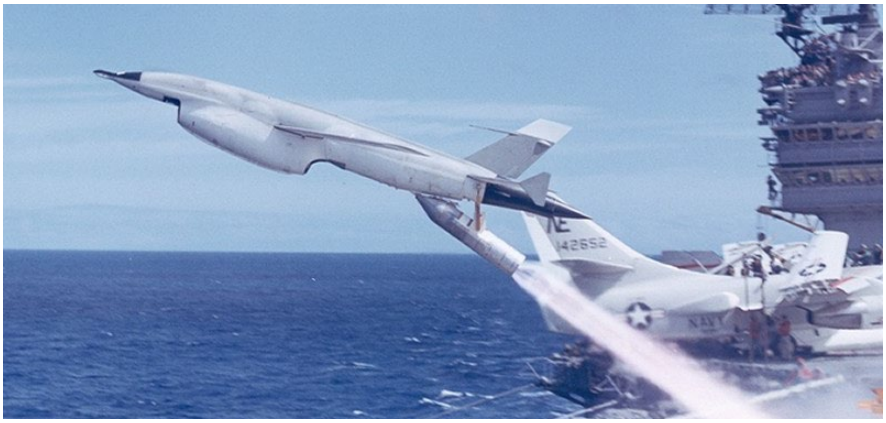

Figure 7. Model 147SK Launching[155]

[151] The QH-50 exacerbated the divide between the surface and air communities in the Navy because the surface officers were tasked with flying it and getting parts from aviation suppliers. Navy pilot also disliked the QH-50 because it complicated the airspace and radio frequency usage around the carrier battle group. See Thomas Pinney, "UAVs: Before Fire Scout There Was DASH," *Proceedings*, August 2018, https://www.usni.org/magazines/proceedings/2018/august/uavs-fire-scout-there-was-dash.

[152] Armstrong, "Armaments & Innovations: DASH, Snoopy, and the Night Panther."

[153] Sloggett, *Drone Warfare: The Development of Unmanned Aerial Conflict*, 86.

[154] David Axe, *Drone War Vietnam* (South Yorkshire, UK: Pen & Sword Books Ltd, 2021), 123.

[155] Launching from *USS Ranger* (CV-61). Source: Rob de Bie, "Model 147SK (US Navy)," accessed January 23, 2022, https://robdebie.home.xs4all.nl/aqm34/147sk.htm.

Though the Navy was not heavily involved in developing uncrewed intelligence-collecting capabilities during the Cold War, this history is important to the present role of uncrewed aircraft in the Navy. Prior uncrewed research split into two channels: missiles and intelligence collection. As the Cold War developed, the desire for uncrewed aircraft capable of high-altitude, long-endurance intelligence collection grew because of the risk discovery posed to crewed aircraft surveillance. The discovery of American U-2 surveillance aircraft over Russia led to a demand for an uncrewed aircraft capable of the same mission with less human risk.[156] Research and development of such an aircraft led to advances in engine technology and electronics to support long missions and communication of information far over-the-horizon from the uncrewed aircraft to a ground control station. These developments paved the way for the over-the-horizon, intelligence-collecting uncrewed aircraft of today.

3. Human Augmentation

In the late 20th century, Douglas Englebart's conceptual framework for human augmentation expanded the potential for uncrewed aircraft by introducing the idea of machine intelligence.[157] Previously, the military focused on creating machines capable of replicating human physical tasks in aircraft such as moving flight controls. Englebart's framework stated that combining humans with machines capable of human cognitive abilities could increase the "capability of a man to approach a complex problem situation."[158] By combining the creativity and emotional perception of humans with the rapid processing and data-intake capacity of machines, the machines would be able to provide fast, relevant information to the human decision-maker, creating a faster more efficient team than one working alone. Human augmentation is a stepping stone between solely human and fully machine-operated systems.

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[156] Sloggett, *Drone Warfare: The Development of Unmanned Aerial Conflict*, 105.

[157] Douglas Englebart, *Augmenting Human Intellect: A Conceptual Framework,* SRI Summary Report (Menlo Park, CA: Stanford Research Institute, 1962), https://www.dougengelbart.org/content/view/138/#6.

[158] Englebart, *Augmenting Human Intellect: A Conceptual Framework*.

In the late 1980s and 1990s, the military created two intelligent machine prototypes to assist pilots with decision-making and information processing. The Air Force and Defense Advanced Research Projects Agency developed the Pilot's Associate to decrease pilot workload in fighter aircraft.[159] The Army's Rotorcraft Pilot's Associate was a futuristic model meant for the next generation scout or attack helicopter.[160] Beyond information management, the assistants offered tactical options based on the mission set and the changing environment. Both assistants were able to analyze the intent of the pilot or crew members by comparing their actions to the original mission set.[161] Based on the analysis, the system offered new suggestions to fit the change in mission or intent.[162] Consequently, these two systems demonstrated the potential for machines to decrease human pilots' cognitive and multi-function roles by making decisions and coordinating information.

B. PRESENT

Though uncrewed aircraft still play a supporting role to the crewed fleet, they are included in carrier air wing planning, evolving to take over more missions from crewed aircraft such as refueling, and becoming more integrated with crewed aircraft. Currently, though most uncrewed aircraft fill intelligence, surveillance, and reconnaissance roles. This section focuses on the three primary uncrewed aircraft in the Navy: MQ-4C Triton, MQ-8 Fire Scout, and MQ-25 Stingray. Unlike the Navy's smaller uncrewed aircraft, these three aircraft both coordinate and share mission sets with crewed aircraft. Whether through refueling crewed fighters, being tightly controlled by human operators, or coordinating with crewed aircraft, these three aircraft illustrate the complementary role uncrewed

[159] S.B. Banks and C.S. Lizza, "Pilot's Associate: A Cooperative, Knowledge-Based System Application," *IEEE Expert* 6, no. 3 (June 1991): 18, https://doi.org/10.1109/64.87681.

[160] C.A. Miller and M.D. Hannen, "The Rotorcraft Pilot's Associate: Design and Evaluation of an Intelligent User Interface for Cockpit Information Management," *Knowledge-Based Systems* 12, no. 8 (December 1999): 443, https://doi.org/10.1016/S0950-7051(99)00035-0.

[161] Miller and Hannen, 446–47.

[162] Ron Brachman, Dave Gunning, and Murray Burke, "Integrated Artificial Intelligence Systems," *AI Magazine* (American Association for Artificial Intelligence, June 2020), 77.

aircraft play in naval aviation. Also, Triton, Fire Scout, and Stingray pilots go through some or all of the same flight training as crewed aircraft pilots.

1. MQ-4C Triton

Based on the Cold War precedent to employ constant air-based surveillance, the Triton evolved out of a 2000 concept study that found a combination of crewed and uncrewed aircraft could effectively provide global intelligence, surveillance, and reconnaissance (ISR) coverage from five American bases located around the world (see Figure 8).[163] Consequently, the Navy invested in modifying the Air Force Global Hawk model, which had originally been a naval initiative in the 1990s before it was handed it off to the Air Force, to fulfill the uncrewed part of the ISR mission.[164]

Figure 8. MQ-4C Triton Initial Flight [165]

For antisubmarine operations, the Triton was intended to work closely and coordinate with the Navy's crewed maritime patrol aircraft, the P8 Poseidon, through a

[163] Ernest Snowden and Robert F. Wood Jr., *Maritime Unmanned: From Global Hawk to Triton* (Annapolis, MD: Naval Institute Press, 2021), 105.

[164] Newcome, *Unmanned Aviation: A Brief History of Unmanned Aerial Vehicles*, 112.

[165] Maiden flight in California on May 22, 2013. Source: Richard R. Burgess, "Triton Deploys at Last: The Navy Takes Its New UAV to the Western Pacific," *Seapower*, April 29, 2020, https://seapowermagazine.org/triton-deploys-at-last-the-navy-takes-its-new-uav-to-the-western-pacific/.

video link. The Poseidon is outfitted with sensors and weapons while the Triton provides additional surveillance capabilities. Each Triton is outfitted with a variety of sensors to provide still and video imagery in real-time that can be used to locate, track, classify, identify targets of interest within a 2,000 nautical mile range.[166] The first inflight video was shared between the two aircraft types in July 2016 as the performance assessment of the Triton was completed.[167]

After the Triton passed the performance assessment, the Navy assimilated the Triton into naval aviation by creating a new squadron and deploying aircraft overseas. The first Triton squadron, Unmanned Patrol Squadron Nineteen (VUP-19), was commissioned in Jacksonville, Florida in October 2016 and official procurement of the aircraft began in fiscal year 2020.[168] Plans are in place to commission a second squadron, VUP-11, in Whidbey Island, Washington.[169] Currently, Triton procurement is paused until fiscal year 2023. Also in 2023, VUP-19 is expected to reach initial operational capability to start providing non-stop "persistent ISR of nearly all the world's high-density sea-lanes, littorals and areas of national interest."[170] However, VUP-19 has already deployed in early 2020 to Guam as part of the initial operational testing of the Triton.[171] Therefore, the Triton is actively contributing to the original goal of the program to provide constant surveillance of the globe.

2. MQ-8 Fire Scout

Stemming from the QH-50, the Fire Scout is a rotary-wing uncrewed aircraft attached to MH-60 crewed helicopter squadrons and littoral combat ships developed to contribute to surface warfare, mine countermeasure, and ISR missions. By coordinating

[166] Snowden and Wood Jr., *Maritime Unmanned: From Global Hawk to Triton*, 13–14.

[167] Snowden and Wood Jr., 11, 235.

[168] For VUP-19 commissioning see: Snowden and Wood Jr., *Maritime Unmanned: From Global Hawk to Triton*, 11; For procurement information see: Mark Cancian, *U.S. Military Forces in FY 2021: Navy,* (Washington, DC: Center for Strategic & International Studies, 2020), 28, https://www.csis.org/analysis/us-military-forces-fy-2021-navy.

[169] Burgess, "Triton Deploys at Last."

[170] Snowden and Wood Jr., *Maritime Unmanned: From Global Hawk to Triton*, 13.

[171] Burgess, "Triton Deploys at Last."

with crewed helicopters and ships, the Fire Scout increases spatial awareness, targeting ability, and the capability to distribute operations between platforms covering a larger amount of space.[172] The current model, MQ-8B, first deployed with crewed helicopters on a littoral combat ship in 2015 (see Figure 9).[173]

Figure 9. MQ-8B Fire Scout Assisting MH-60R[174]

By 2024, the more advanced and versatile MQ-8C is planned to replace the MQ-8B in MH-60 squadrons (see Figure 10).[175] The newer Fire Scout offers more range, payload, and endurance.[176] The MQ-8C met initial Navy performance requirements and

[172] Justin Katz, "DOT&E Says Fire Scout Is 'Not Operationally Effective,' Reveals Navy Created 'Tiger Team,'" Inside Defense, February 4, 2020, https://insidedefense.com/daily-news/dote-says-fire-scout-not-operationally-effective-reveals-navy-created-tiger-team.

[173] NAVAIR, *Navy Aviation Vision 2030-2035*, 13.

[174] Source: Megan Eckstein, "Navy Fielding MQ-8C Fire Scout to Operational Squadrons Ahead of Deployment Next Year," USNI News, last modified October 5, 2020, https://news.usni.org/2020/10/05/navy-fielding-mq-8c-fire-scout-to-operational-squadrons-ahead-of-deployment-next-year.

[175] Megan Eckstein, "LCS Fort Worth Integrates Fire Scout UAV, RHIBs Into Bilateral Exercises For First Time," USNI News, last modified August 26, 2015, https://news.usni.org/2015/08/26/lcs-fort-worth-integrates-fire-scout-uav-rhibs-into-bilateral-exercises-for-first-time.

[176] Sloggett, *Drone Warfare: The Development of Unmanned Aerial Conflict*, 111.

was granted initial operating capability in June 2019.[177] In late 2020, the first two aircraft were delivered to the fleet to begin integration into daily operations with the MQ-8B, crewed helicopters, and littoral combat ships on deployment.[178] In the future, the MQ-8C is expected to perform surface warfare and mine countermeasure missions. The surface warfare capability is being tested, and the mine countermeasures capability is still in development.[179] Currently, pilots within the squadrons alternate between crewed and uncrewed aircraft, so one day they may fly inside an MH-60 and the next day be on the ground controlling one of the Fire Scouts.[180]

Figure 10. MQ-8C[181]

[177] Katz, "DOT&E Says Fire Scout Is 'Not Operationally Effective,' Reveals Navy Created 'Tiger Team.'"

[178] Eckstein, "Navy Fielding MQ-8C Fire Scout to Operational Squadrons Ahead of Deployment Next Year."

[179] Katz, "DOT&E Says Fire Scout Is 'Not Operationally Effective,' Reveals Navy Created 'Tiger Team.'"

[180] Eckstein, "Navy Fielding MQ-8C Fire Scout to Operational Squadrons Ahead of Deployment Next Year."

[181] Source: Wikipedia, s.v. "Northrup Grumman MQ-8C Fire Scout," last modified December 22, 2021, https://en.wikipedia.org/w/index.php?title=Northrop_Grumman_MQ-8C_Fire_Scout&oldid=1061634176.

3. MQ-25 Stingray

Unlike the land-deployed Tritons and relatively small Fire Scouts, the large carrier-deployed Stingrays have caused organizational changes within the conventional carrier air wing model.[182] The Navy's newest addition to the uncrewed inventory, the MQ-25 Stingray, first flew on September 19, 2019, for a two-hour flight performance and operational check.[183] Two years later, the prototype demonstrated the ability to perform its primary refueling mission by refueling a variety of crewed naval aircraft (see Figure 11).[184] Most recently, in December 2021, the testing model completed deck handling tests on an aircraft carrier to determine suitability for carrier operations and integration within the carrier environment**.** It is supposed to reach its initial operating capability in 2025. The Stingray, controlled from a specialized station installed within the carrier, will provide ISR capabilities and take over the refueling mission from the modified strike fighters currently being used to refuel carrier-based aircraft. The Navy is in the process of modifying the composition of aircraft in the carrier air wing to create space for Stingrays because aircraft storage space is limited.[185]

[182] NAVAIR, *Navy Aviation Vision 2030-2035*, 10–11.

[183] NAVAIR, "Navy, Boeing Complete First MQ-25 Test Flight," Naval Air Systems Command, September 19, 2019, https://www.navair.navy.mil/news/Navy-Boeing-complete-first-MQ-25-test-flight/Wed-09182019-1122.

[184] Mallory Shelbourne, "Navy Wraps Up MQ-25A Deck Handling Tests on Carrier USS George H.W. Bush," USNI News, December 22, 2021, https://news.usni.org/2021/12/22/video-navy-wraps-up-mq-25a-deck-handling-tests-on-carrier-uss-george-h-w-bush.

[185] NAVAIR*, Navy Aviation Vision 2030-2035*, 10–11.

Figure 11. MQ-25 Refueling F-35C[186]

The Stingray is also distinct from the other uncrewed aircraft because the pilots for the Stingray are warrant officers recruited from civilian and enlisted populations instead of unrestricted line officers.[187] Triton and Fire Scout pilots either flew or still fly crewed aircraft. The Navy created a new warrant designator, Aerial Vehicle Operator, to fill pilot billets within the Stingray community.[188] The first class was selected in July 2021 for the abbreviated flight training pipeline leading to a career in uncrewed operations.[189] Initially, these operators will be tasked solely with operating the aircraft, while traditional unrestricted line officers will fill out leadership positions within the squadrons.[190]

[186] Taken on September 3, 2021. Source: Wikipedia, s.v. "Boeing MQ-25 Stingray," last modified December 19, 2021, https://en.wikipedia.org/w/index.php?title=Boeing_MQ-25_Stingray&oldid=1061037098.

[187] The distinction between warrant and unrestricted line officers includes career path differences. Warrant officers are considered specialists in their field who do not compete for command. Unrestricted line officers have a specialty, but they must also hold certain jobs outside of that specialty to be competitive for promotion and command. For information on Stingray warrant officers see: Navy Personnel Command, "Applicant Information," MyNavy HR, 2022, https://www.mynavyhr.navy.mil/Career-Management/Community-Management/Officer/Active-OCM/LDO-CWO/Applicant-Information/. For more information on officer types see: Lesa A. McComas and J.D. Kristensen, *The Naval Officer's Guide*, 13th ed. (Annapolis, MD: Naval Institute Press, 2019), 217, 219.

[188] Navy Personnel Command.

[189] Navy Personnel Command.

[190] Navy Personnel Command.

Eventually, the operators may alternate between Stingray and Triton billets as they rotate between shore and sea duty tours.[191]

C. FUTURE

Future warfare designs include plans for further distancing of humans from the cockpit and battlefield. Research that integrated cognitive abilities and machines, such as the pilot assistants of the late 20th century, has paved the way for increased integration of uncrewed machines on the battlefield. The next generation air warfare concept, known as mosaic warfare within the military, is based around a distributed network of elements including aircraft where a human operator can control and manage multiple aircraft types, both crewed and uncrewed, while their aircraft is operated by artificial intelligence (see Figure 12).[192] Operations are distributed between uncrewed and crewed elements capitalizing on the endurance and quick decision-making and sensing abilities of the machines and the coordination, creativity, and management skills of humans.[193] Instead of being created for a fixed role within an operation, pieces of the mosaic are adaptable and can be mixed and matched as the situation demands. Operations are also distributed across domains and military branches, creating an unpredictable complex force that can overwhelm and confuse the adversary force.[194] Seamless coordination and acquisition and analysis of information will allow the military to take control of complex battlefield environments using a changeable mosaic of capabilities.

[191] Navy Personnel Command.

[192] Cliff Drubin, "AlphaDogfight Trials Foreshadow Future of Human-Machine Symbiosis," *Microwave Journal* 63, no. 10 (October 1, 2020): 33.

[193] Department of the Navy, *Department of the Navy Unmanned Campaign Framework* (Washington, DC: Department of the Navy, 2021), 10, https://www.navy.mil/Portals/1/Strategic/20210315%20Unmanned%20Campaign_Final_LowRes.pdf?ver=LtCZ-BPlWki6vCBTdgtDMA%3d%3d.

[194] "DARPA Tiles Together a Vision of Mosaic Warfare," DARPA, accessed January 22, 2022, https://www.darpa.mil/work-with-us/darpa-tiles-together-a-vision-of-mosiac-warfare.

Figure 12. Visual of Mosaic Warfare[195]

Government implementation of the Third Offset Strategy, announced in 2014, ensured dedication to using human-machine teaming throughout the military.[196] The Third Offset Strategy is based on the ability of the military to leverage technology and conventional weapons to create human-machine teams to deter great power competition from China and Russia now and in the future. To ensure American victory in deterrence or potential conflict should deterrence fail, the strategy focuses on five areas of innovation: "autonomous learning systems, human-machine collaborative decision-making, assisted human operations, advanced manned-unmanned systems operations, and network-enabled autonomous weapons and high-speed projectiles."[197] Mosaic warfare operations fit neatly with this vision of complex but adaptable networks of human and machine assets, often

[195] Source: DARPA, "DARPA Tiles Together a Vision of Mosaic Warfare."

[196] Secretary of Defense Chuck Hagel announced the Third Offset Strategy in 2014 at the Reagan Defense Forum. See: "Reagan Defense Forum: The Third Offset Strategy," U.S. Department of Defense, last modified November 7, 2015, https://www.defense.gov/News/Speeches/Speech/Article/628246/reagan-defense-forum-the-third-offset-strategy/. For further analysis of the Third Offset Strategy see: Aaron Wellman, "Parity Avoidance: A Proactive Analysis of the Obsolescence of the Third Offset Strategy" (Thesis, Monterey, CA; Naval Postgraduate School, 2019), 21, https://calhoun.nps.edu/handle/10945/62314

[197] Jesse Ellman, Lisa Samp, and Gabriel Coll, *Assessing the Third Offset Strategy* (Washington, DC: Center for Strategic & International Studies, 2017), 3, http://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/170302_Ellman_ThirdOffsetStrategySummary_Web.pdf.

paired to leverage the capabilities of both. For the Navy, implementation of the Third Offset Strategy and mosaic warfare mean increased development and integration of uncrewed systems with humans and crewed assets in the air, surface, and sub-surface domains.

Within naval aviation, implementation of mosaic warfare and the Third Offset Strategy includes integrating old and new assets into a more networked human-machine model of operations.[198] For instance, while the F-35 Strike Fighter was developed before the ideas of mosaic warfare and the Third Offset Strategy were conceptualized, it showcases the future of human-machine teaming because its power lies in the ability to harness both human and machine capabilities to produce a more effective outcome than a human or machine could alone. Consequently, it has been labelled the "reconnaissance strike complex of the 21st century" because it leverages the capabilities of both humans and machines to create a team capable of making faster decisions in more complex environments.[199] Despite being a fighter aircraft, the F-35 is not optimized for close-up combat since it is incapable of matching the physical performance of the previous generation strike fighter.[200] Instead, the pilot, assisted by the aircraft's advanced automation, can engage the battlespace quickly from afar while staying away from direct combat. Similarly, the next steps for the helicopter community are to create "a family of manned and unmanned systems which will be a key component of our distributed maritime operations" foreshadowed by the development and use of the MQ-8 Fire Scout.[201]

Naval aviation's current emphasis on having fewer humans on the battlefield, leading to an increased focus on automation and artificial intelligence, predicts a future

[198] The Third Offset Strategy and mosaic warfare describe seamless human-machine integration as the cutting edge of research and development, where crewed and uncrewed assets can be inserted and removed smoothly and easily in the battlefield. Current uncrewed aircraft such as the MQ-25 Stingray and MQ-8C Fire Scout are still undergoing testing and updates and are not fully physically integrated into the fleet. They operate with a limited number of other assets. They are not able to be added in and out as equal members of the fleet yet.

[199] Department of Defense, "Reagan Defense Forum."

[200] Department of Defense, "Reagan Defense Forum."

[201] Mallory Shelbourne, "Admiral: Next Navy Helos Will Be Mix of Manned, Unmanned," USNI News, last modified April 1, 2021, https://news.usni.org/2021/04/01/next-navy-helos-will-be-mix-of-manned-unmanned.

where uncrewed aircraft are not adjuncts but primary players. Recent descriptions of uncrewed aircraft in the Navy's future invoke a world in between the current reality and the future the Air Force anticipates where autonomous aircraft occupy a primary role.[202] Though the Navy continues to promote crewed over uncrewed aircraft, the Air Force, through artificial intelligence developments, is moving faster toward fighter aircraft completely capable of operating themselves with limited human oversight. In the Air Force's Air Combat Evolution program, artificial intelligence flies the aircraft and engages other aircraft.[203] A pilot who may or may not be sitting in the aircraft is responsible for prioritizing targets, selecting the best weapon, and deciding on the overall engagement strategy in the battlespace, which may include allied uncrewed aircraft.

The April 2021 Unmanned Integrated Battle Problem 21 Exercise is significant because it illustrated the shifting power relationship between the two types of assets, though it is inaccurately deemed the first coordinated exercise between uncrewed and crewed assets within the Navy.[204] Before the exercise, performance testing of specific uncrewed platforms was usually paired with one or a couple of other platforms, such as the Fire Scout and littoral combat ships, and isolated from the majority of fleet assets. However, this exercise pulled them out of isolation and pitched them into the hypothetical fire to evaluate how well current crewed and uncrewed assets could communicate, share information, and work together as a unified force. Though communication advancements

[202] Based on documents mentioned earlier including the *2021 CNO NAVPLAN, Navy Aviation Vision 2030-2035*, and the *Department of the Navy Unmanned Campaign Framework*. The distinction between the Navy and Air Force is the Air Force's emphasis on distancing the human as much as possible and making the human an overall battlefield manager in control of multiple assets simultaneously. The Navy is still focused on having crewed elements within the battlefield, though there will be a large percentage of uncrewed assets.

[203] Ken Plaks, "Air Combat Evolution (ACE)," Defense Advanced Research Projects Agency, accessed August 10, 2021, https://www.darpa.mil/program/air-combat-evolution. For more information see: DARPAtv, "AlphaDogfight Trials Final Event."; Cliff Drubin, "AlphaDogfight Trials Foreshadow Future of Human-Machine Symbiosis," *Microwave Journal, International Ed.* 63, no. 10 (October 1, 2020): 33, http://www.proquest.com/docview/2459470531/abstract/3E083366C6214DD0PQ/1.

[204] This chapter establishes the shared history unmanned aircraft development has with naval aviation. Many naval exercises before 2021 have included unmanned aircraft. For instance, Section A.1 of this chapter mentioned the exercise involving TDD target drones on August 24, 1938. Megan Eckstein, "Navy Kicks Off First Fleet Exercise Focused On Role of Unmanned Systems," USNI News, last modified April 19, 2021, https://news.usni.org/2021/04/19/navy-kicks-off-first-fleet-exercise-focused-on-role-of-unmanned-systems.

are needed, this exercise demonstrated the naval vision of a fully integrated hybrid fleet, where uncrewed platforms will work in the sub-surface, surface, and air domains as peer or dominant, instead of historically subservient, partners of crewed assets.

D. CONCLUSION

The development of uncrewed aircraft within naval aviation has historically followed a pendulum's path, alternating between keen attention and disinterest when test flights failed, or attention moved to a shinier project. Naval development and implementation of uncrewed aircraft has started and stopped based on the technology available, needs of the Navy, the perceived potential of the aircraft, and the interest of high-level individuals within the Navy. As the potential capabilities of uncrewed aircraft were explored and broadened, including the development of intelligent-machine pilot assistants, the concept of uncrewed aircraft narrowed and became more specialized. Currently, the Navy's primary uncrewed aircraft complement a multitude of naval missions by fulfilling duties like refueling, targeting, and visual reconnaissance. In the future, they are predicted to hold a leading role on a battlefield completely integrated with other crewed and uncrewed assets.

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III. IDENTITY IN THE SAIL-TO-STEAM TRANSITION

In the transition from sail-to-steam power in the mid-to-late 1800s, the resistance of a segment of line officers slowed the development and implementation of steam technology within the Navy.[205] Through the lens of two identity theories, this chapter focuses on the identity factors that slowed down the adoption of new technology within the Navy. Individual identity factors are analyzed through identity theory while group identity factors are examined through social identity theory.[206] This case study illustrates the social components of technological change and highlight how individual and group fears for survival affect the trajectory of technological development.

A. BACKGROUND

The 1800s were a turbulent time for the Navy, not only because of multiple foreign and domestic wars but because of the number of new technologies introduced. After the development of sail-powered caravel vessels in the late 15th century, naval forces around the world primarily used sailing ships built from wood.[207] Though the American Navy was relatively new in the 1800s, it emulated the sail-powered wooden ship model used at the time.[208] Throughout the 19th century, the classic sail-powered ship model was modified and changed by many new technologies including iron-cladding, shell-encased ordnance,

[205] The line officer corps was split over supporting steam power. This analysis focuses on those who did not support steam power. For information about steam power advocates see: William M. McBride, *Technological Change and the United States Navy: 1865-1945* (Baltimore, MD: Johns Hopkins University Press, 2000), 12; William E. Griffis, *Matthew Calbraith Perry: A Typical American Naval Officer* (Boston, MA: Cupples and Hurd, 1887), 112–13.

[206] Refer to Chapter I Section C.2 descriptions of identity theory and social identity theory.

[207] Jean Vaucher, "History of Ships: Ships of Discovery," Universite de Montreal, last modified April 2019, https://www.iro.umontreal.ca/~vaucher/History/Ships/Ships_Discovery/index.html.

[208] Adam Bisno, "Washington Signs the Naval Act of 1794," Naval History and Heritage Command, last modified February 2019, https://www.history.navy.mil/content/history/nhhc/browse-by-topic/heritage/origins-of-the-navy/washington-naval-act-1794.html.

and steam power.[209] The advent of steam power, in particular, highlights the clash of individual and group identities associated with sail and steam technology. Overall, this section analyzes three episodes in the mid-1800s where identity factors inhibited the development of steam power in the Navy: legislative changes to the naval officer corps in 1866 and 1870, sail-focused executive orders issued in the late 1860s, and the condemnation of the steamship *Wampanoag* in 1869.

Like the long and slow development of uncrewed aircraft in naval aviation, steam power was not suddenly invented and implemented overnight. The first steam warship in the world, *Demologos* or *Fulton I* (see Figure 13), was tested in the United States in July 1815, steaming for more than eight hours without sail power.[210] Designed as a harbor defense model for the War of 1812 but not finished before the war ended, the Navy used the *Demologos* as a floating barracks because it did not fit the post-war overseas-commerce protection mission.[211] Though the 1816 Act for the Gradual Increase of the Navy called for three steam-powered ships like the *Demologos*, production was delayed by the economic panic of 1819.[212] Therefore, steam power did not challenge sail power in the early 1800s because the Navy did not build many steam-powered vessels.

[209] Elting E. Morison, *Men, Machines, and Modern Times* (Cambridge, MA: MIT Press, 1966), 34.

[210] Frank M. Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps* (Pittsburgh, PA: Warren & Co., Publishers, 1896), 12, https://hdl.handle.net/2027/uc1.b4480080.

[211] The Coast and Harbor Defense Association recommended the *Demologos* be used as a training vessel to familiarize personnel with steam power, but it was only used as a floating barracks. McBride, *Technological Change and the United States Navy: 1865-1945*, 10–11.

[212] McBride, 11.

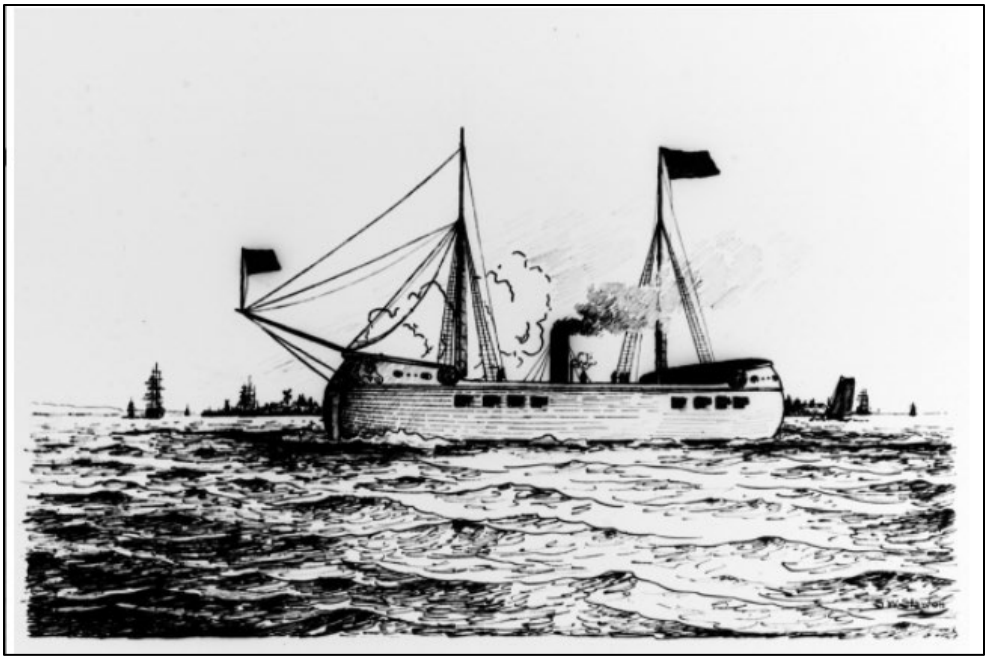

Figure 13. Ink Drawing of the *Demologos*[213]

In the 1860s, the Civil War served as a catalyst to increase steam-powered vessels and the associated engineers as the Union scrambled for people and assets to fight the Confederacy.[214] In 1860, there were only 174 engineers in the Navy compared to 501 in 1863.[215] However, once the war's urgency faded after 1865, identity-based resistance to steam power increased as many line officers resisted the changes steam power introduced to their role and authority onboard naval vessels. Meanwhile, by the 1860s, steamships were common in commercial shipping, visiting ports in India, China, and the West Indies.[216] Commercial shippers adopted steam power because steamships were faster than

[213] Source: "NH 65461 Steam Battery," Naval History and Heritage Command, accessed March 17, 2022, https://www.history.navy.mil/content/history/nhhc/our-collections/photography/numerical-list-of-images/nhhc-series/nh-series/NH-65000/NH-65461.html.

[214] McBride, *Technological Change and the United States Navy: 1865-1945*, 12–13.

[215] United States Bureau of Naval Personnel, *Register of Commissioned and Warrant Officers of the United States Navy and Marine Corps and Reserve Officers on Active Duty* (Washington, DC: Government Printing Office, 1860), 88–94; United States Bureau of Naval Personnel, *Register of the Commissioned and Warrant Officers of the United States Navy and Marine Corps and Reserve Officers on Active Duty* (Washington, DC: U.S. Government Printing Office, 1863), 62–79.

[216] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 16.

sailing vessels, and when combined with steam propellers and compound engines, shippers could transport more cargo.[217]

B. CAREERS THREATENED: 1866 AND 1870 CHANGES TO OFFICER CORPS

Though Gideon Wells, Secretary of the Navy during the Civil War, encouraged the implementation of steam power within the Navy, the reduction of forces at the war's end reestablished the dominance of line officers over the engineers in charge of the steam power plants. During the war, the number of steam ships and engineers had quickly increased, changing the ratio of the Navy's officer corps from primarily line officers and few engineers to the same number of line officers, but a larger percentage of engineers.[218] In the 1863 Annual Report, Wells declared that "sails are subordinate to steam" and that "steam engineering should indeed be one of the important studies of all naval officers."[219] Despite Wells' advocation for steam power, steam did not become the dominant propulsion system until two decades later because some line officers resisted the new technology and feared the domination of engineers.[220]

1. Line Officer Role and Authority Endangered

The line officer's role clashed with the steam engineer's role because the engineer removed the line officer's ability to maneuver the ship.[221] The line officer on a sail-powered ship not only commanded the personnel and decided how to use the ship to engage an enemy, but also exercised direct control over the ship's movement.[222] A line officer, located above the deck within visual sight of the sails, controlled the ship's source of

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[217] S.G.W. Benjamin, "Evolution of the Ocean Steamship," Gjenwick-Gjonvik Archives, accessed April 14, 2022, https://www.gjenvick.com/OceanTravel/TransatlanticShipsAndVoyages/OceanSteamships/1882/Part1-EvolutionOfOceanSteamships.html?msclkid=de383215bc0811ec9b64372b30265abd.

[218] McBride, *Technological Change and the United States Navy: 1865-1945*, 12.

[219] United States Navy Department, *Annual Report of Secretary of Navy* (Washington, DC: U.S. Government Printing Office, 1863), xix.

[220] Griffis, *Matthew Calbraith Perry*, 112–13; Denis Ringle, *Life in Mr. Lincoln's Navy* (Annapolis, MD: Naval Institute Press, 1998), 7.

[221] McBride, *Technological Change and the United States Navy: 1865-1945*, 13.

[222] McBride, 13.

propulsion. On steamships, line officers no longer had sole command of the ship and relied on steam engineers to maneuver the ship as the line officer directed. Consequently, conflict over propulsion control was centered between line officers and engineers.

According to identity theory, the removal of a task related to the line officer role exemplifies the relationship among role, behavior, and identity because role-based identities are reinforced by consistent behaviors enacted when in a specific role.[223] When an individual cannot perform the expected behaviors, his or her identity cannot be verified, which can result in feeling angry, incompetent, ashamed, and confused.[224] As the tasks associated with the engineer and line officer roles overlapped, line officers struggled to maintain their authority over the ship and their role-related identities.

The engineer and line officer roles were distanced by different rank structures.[225] Line officers in the mid-1800s had similar titles to today's naval officers, from midshipmen to rear admiral.[226] Instead of putting engineers into the same rank structure, the Navy put them into the staff officer rank structure and created a relative ranking system in 1863, with each engineering rank equivalent to a line officer rank.[227] For instance, a chief engineer started as equal to a lieutenant commander and, after five years, a commander.[228] Because four ranks were added to the line officer but not the staff rank structure in 1862, the relative rank system was created to fill the gaps in the engineer structure.[229]

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[223] Burke and Stets, *Identity Theory*, 116.

[224] Burke and Stets, 159.

[225] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps,* 401.

[226] Line officer progression as of 1862: midshipman, ensign, master, lieutenant commander, commander, captain, commodore, rear admiral. McBride, *Technological Change and the United States Navy: 1865-1945*, 14.

[227] Engineering rank system: 3rd assistant engineer, 2nd assistant engineer, 1st assistant engineer, chief engineer, captain, chief of staff, chief of bureau, fleet staff officer (when an executive officer). Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 401.

[228] Bennett, 401.

[229] Bennett, 401.

Despite the equivalent rank system, having two different structures confused who had authority on a ship: the engineer or line officer.[230] It also implied that the role of a line officer correlated directly to the authority endowed by their rank while the engineer role was directly linked to the job as an operator of the steam engine. A general order from the Navy Department in September 1863 stated that:

> engineers will hereafter understand that the condition of the machinery under their charge on the arrival of the vessel from a cruise will be considered as a test of their efficiency and fidelity in the discharge of their duties…the result of the examination then made will determine whether they have discharged their duties in such a manner as to deserve commendation, or have been so grossly negligent or incompetent as to render their expulsion from the service.[231]

This order affirms the connection between the engineer role and operating a ship's steam power plant while avoiding any mention of authority over personnel.

Consequently, line officers and engineers often had tense relationships that created internal conflict within the ship where line officers did not recognize the authority of the engineers.[232] For instance, one assistant engineer wrote in a letter in 1876 that engineers "have no rights or place assigned them aboard ship" and that the "Chief Engineer can't do anything."[233] Similarly, more than 300 line officers endorsed a letter to the Secretary in the Navy in 1878 that stated "the Line [officers] of the navy fights the ships; the Line sails and maneuvers the ships; the Line governs and organizes the crew…the Staff Corps are adjuncts, necessary it is granted, but still adjuncts."[234] This letter sets a clear line establishing the authority of line officers over all staff officers, including engineers.

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[230] Peter Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism* (New York, NY: Free Press, 1972), 66–67.

[231] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 402.

[232] Line Officers, "Letter to Secretary of the Navy," January 22, 1878, 11, https://www.navyhistory.org/wp-content/uploads/2013/04/22Jan1878ltrtoSECNAV.pdf; Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 67.

[233] Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 67.

[234] Line Officers, "Letter to Secretary of the Navy," January 22, 1878, 11.

Therefore, the relationship between a line officer and engineer became a battleground for role-related status and authority.

Line officer status and authority were further threatened by the fluctuations of the officer corps size in 1866 and 1870 because promotion chances decreased. During the Civil War, the Navy recommissioned veterans who had been line officers at the rank they would have been in had they not left.[235] At the end of the war, the recommissioned veterans occupied the higher ranks, leaving fewer open slots for other officers to be promoted.[236] By increasing the number of line officers allowed in the Navy by 400 in 1866, Congress made promotions more difficult because it did not create more billets for officers to be promoted into.[237] Thus, there were more people competing for the same number of promotions. Meanwhile, the Navy also reduced the number of engineers allowed in the service to pre-Civil war levels and failed to retain enough to operate the vessels with working steam engines.[238]

Decreasing available promotions threatened individual identity because officers used rank and promotions to measure their authority and position among other officers. According to historian Lance Buhl, "from an officer's point of view, his grade and particularly his rank…constituted the measure of career progress" and "defined his personal status and authority within the service relative to any other officer."[239] Younger officers, who had served since before the Civil War began, felt held back and passed over by people with less sea experience.[240] Line officers resorted to seeking redress of their grievances through Congress when they felt passed over in promotions or another officer

[235] Lance C. Buhl, "Mariners and Machines: Resistance to Technological Change in the American Navy, 1865-1869," *The Journal of American History* 61, no. 3 (1974): 724, https://doi.org/10.2307/1899928.

[236] Buhl, 724–25.

[237] Buhl, 723.

[238] Buhl, 724; By 1867, there were 293 engineers in the Navy. See: Register of Commissioned and Warrant Officers of the United States Navy and Marine Corps and Reserve Officers on Active Duty, 1867, 52–63.

[239] Buhl, "Mariners and Machines," 724.

[240] Buhl, 725.

successfully won a redress action.[241] Redress of grievances is an individual right granted by the first amendment of the Constitution to complain and appeal to the government about a problem without fear of punishment.[242] When Congress promoted an officer through redress, other officers perceived the promotion as unfair, and sought their own promotions via Congress, creating a self-sustaining cycle of complaints.[243]

The line officers' attempts to reestablish control over their careers, authority, and identity illustrate identity theory's point that individuals will try to bring the threatening situation under control so that they can successfully fulfill their perceived identity.[244] After receiving many petitions and complaints from disgruntled line officers, Congress reduced the size and pay of the officer corps in 1870, which only exacerbated individual desperation and fear for career survival.[245]

2. Line Officers and Engineers: In-Group and Out-Group

The culture clash between line and staff officers, exemplified by the engineers, models out-group and in-group behavior detailed in social identity theory. Line officers, historically established, were the in-group, and the newly established engineers became the out-group. As the number of engineers increased during the Civil War, their presence became more noticeable, and they began to demand more equality in status, berthing, and wardroom rights with line officers.[246] According to historian James Bradford, engineers saw their group and associated steam technology to be the "heralds and makers of a bold new era of American naval history" when steam power would triumph over sail power.[247]

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[241] Buhl, 725.

[242] Library of Congress, "Constitution of the United States: First Amendment," Constitution Annotated: Analysis and Interpretation of the U.S. Constitution, accessed April 11, 2022, https://constitution.congress.gov/constitution/amendment-1/.

[243] Buhl, "Mariners and Machines," 725.

[244] Burke and Stets, *Identity Theory*, 164.

[245] Buhl, "Mariners and Machines," 725.

[246] Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 66.

[247] James Bradford, ed., *Captains of the Old Steam Navy: Makers of the American Naval Tradition, 1840-1880* (Annapolis, MD: Naval Institute Press, 2012), 315.

However, from the line officer group perspective, as the theory holds, engineers did not meet the social and cultural requirements to be accepted as equals. The distinction line officers perceived between the two groups illustrates social identity theory's process for creating in-groups and out groups because the line officers emphasized the social and cultural differences between themselves and the engineers.[248] Based on academic Peter Karsten's research, line officers, primarily graduates of the Naval Academy in the mid-to-late 1800s, came from the "commercial, industrial, and professional elite" that owned industry and had political power.[249] Only one out of every seven was from a middle- instead of upper-class background and fewer than one percent came from the enlisted ranks.[250] Furthermore, Karsten wrote that line officers as a group cultivated an upper-class "sense of art and cultural trappings" and were "conservative and ideologically committed to the preservation of the existing framework of social control."[251] The few pre-war engineers fit with the line officer aristocracy because they also came from the upper class.[252] However, the engineers of the war and the post-war era were primarily from lower and middle social classes, often pulled from the working-class ranks of the merchant marine.[253] Engineers, as members of a relatively new profession, had little backing from professional organizations, unlike the line officers, who were a well-established group within the Navy.[254] Consequently, engineers did embody the characteristics line officers associated with naval officers, and engineers became an out-group with a separate set of group norms, characteristics, and behaviors.

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[248] "Social Identity Theory," Learning Theories, accessed November 10, 2021, https://www.learning-theories.com/social-identity-theory-tajfel-turner.html.

[249] Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 10.

[250] Karsten, 7, 13.

[251] Karsten, 71.

[252] McBride, *Technological Change and the United States Navy: 1865-1945*, 13.

[253] Buhl, "Mariners and Machines," 715; For use of merchant mariners see: Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 503.

[254] Buhl, "Mariners and Machines," 714.

3. Result

Tensions flared between engineers and line officers as a result of increasing numbers of engineers in the Navy during the Civil War and the subsequent fluctuations in the size of the officer corps. Line officers fought to maintain their unique identity, captured in Alfred Mahan's statement that engineers "snored away below while line officers fought the ship." [255] In this statement, Mahan implies that the line officer was the authoritative figure responsible for the ship. Line officers did not perceive engineers as an equal or vital to fighting the ship.[256] The tension between roles contributed to the staff-line officer controversy that continued for decades.[257] Furthermore, as engineers all but disappeared, steam power development slowed.[258] Sail power remained the primary propulsion method for naval vessels for decades.

C. REINFORCEMENT OF THE SAIL TRADITION: 1860S EXECUTIVE ORDERS

In 1869, Rear Admiral Porter (see Figure 14) issued two executive orders that reinforced sail power as the primary propulsion method in the Navy.[259] The first, Number 128, declared that all steam vessels except tugs and small courier vessels had to be outfitted with sails.[260] Thus, sails were installed on steam-only ships, and four-bladed propellers were replaced with two-bladed propellers because the two-bladed propellers produced less

[255] Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 65.

[256] Line Officers, "Letter to Secretary of the Navy," January 22, 1878, 11.

[257] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 403; Buhl, "Mariners and Machines," 726.

[258] McBride, *Technological Change and the United States Navy: 1865-1945*, 18.

[259]Adolph Borie was the actual Secretary of the Navy at this time. Since Borie was not very knowledgeable about how to operate naval forces, Porter assisted him for three months in 1869. In March 1869, Porter issued a general order stating that any orders coming from him were to be interpreted as coming from the Secretary of the Navy. See Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 66.

[260] United States Navy Department, *General Orders and Circulars Issued by Navy Department from 1863 to 1887* (Washington, DC: Government Printing Office, 1887), 82, ProQuest.

drag when using sails.[261] The second, Number 131, mandated that normal ship cruising must be done under sail power; steam power could only be used under the "most urgent circumstances," and commanding officers had to justify using steam via special reports to the fleet commander and Navy Department.[262] Together, these mandates restricted the use of steam by requiring the use of sail power.

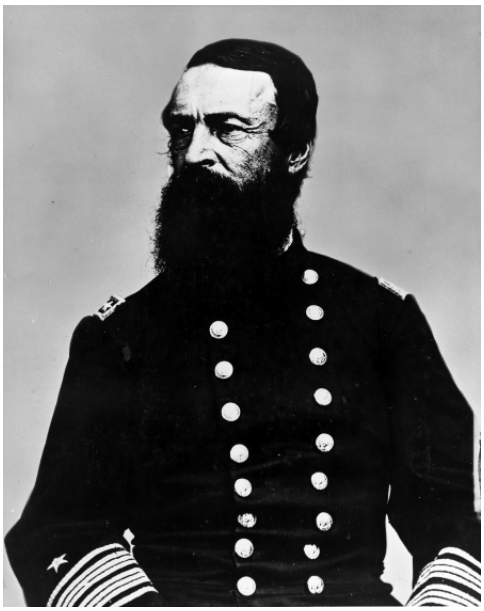

Figure 14. Rear Admiral David Dixon Porter circa 1865[263]

1. Symbolism of the Line Officer Role

For line officers, the lore and tasks associated with commanding a sail-powered vessel gave meaning to their role in the Navy.[264] Naval life was romanticized through

[261] For a discussion on the technical performance of two-bladed versus four-bladed propellers see: Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps,* 639–43.

[262] United States Navy Department, *General Orders and Circulars Issued by Navy Department from 1863 to 1887*, 83–84.

[263] Source: "NH 61921 Rear Admiral David Dixon Porter, USN," Naval Heritage and History Command, accessed March 2, 2022, https://www.history.navy.mil/content/history/nhhc/our-collections/photography/numerical-list-of-images/nhhc-series/nh-series/NH-61000/NH-61921.html.

[264] McBride, *Technological Change and the United States Navy: 1865-1945*, 4.

literature, some written by line officers, that emphasized the power and beauty in sails.[265] For instance, in his memoir, *Naval Life: Or, Observations Afloat and on Shore*, Lieutenant William Lynch wrote, "the greatest perfection of art, is it not a ship, buoyant and graceful, under a cloud of canvas, buffeting the elements, and against wind or tide or current…?"[266] Not only was there perceived aesthetic beauty in a billow of white canvas but there was a power invested in the individual who could manipulate the elements to make a ship move through wind power alone. Sail symbology demonstrates identity theory's conclusion that signs and symbols are the resources people use to satisfy identity requirements because sails represented the source of a line officer's identity as well as their authority.[267] In that same memoir, Lynch described the men who gleaned power from sails as "inured by degrees to the dangers of a new element" and capable of wandering "over the fathomless ocean in quest of other worlds."[268] For centuries, sail power had given explorers, pirates, and other seafarers power and the ability to reach other lands and resources.[269] The naval line officer was one more in a long line of individuals capable of harnessing the wind to his own desires. While there was a sense of domination over nature, line officers had to understand nature to successfully manipulate wind power.

Steam power and the associated engineers challenged the beauty and power associated with sails because steam power gave control to engineers and removed the need for sails. Removing the sails is an example of what identity theory calls a disturbance because sails were the primary symbol that represented the line officer identity.[270] In the mid-1800s, Matthew C. Perry's biographer wrote that reverence of sail power was likened

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[265] Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 70–71.

[266] William Francis Lynch, *Naval Life: Or, Observations Afloat and on Shore. The Midshipman* (New York, NY: Scribner, 1851), 132.

[267] Burke and Stets, *Identity Theory*, 108.

[268] Lynch, *Naval Life*, 132.

[269] Vaucher, "History of Ships: Ships of Discovery."

[270] Burke and Stets, *Identity Theory*, 106.

to "sacredness of an article of religion."[271] Sails were also relatively clean and quiet while steam engines and paddlewheels were loud and messy, undoing the poetic nature and beauty of the relationship between line officer, nature, and vessel. In his history of steam power in the Navy, Bennett wrote about the

> jealousy felt by sailors of the old school toward the un-naval men of gauges and stop-cocks. They foresaw only too clearly that steam was to steal away the poetry of the sea, turn the sailor into a coal heaver, and the ship into a machine.[272]

This statement illustrates how some naval personnel feared steam power and engineers would replace the artistic characteristics inherent in sail power.

For 19th-century sailors, such as Perry, the sail aesthetic connected to the sailor identity.[273] He described the sail-powered *North Carolina* (see Figure 15) as a "stately vessel under her mass of snowy canvas" that "filled a true sailor with profound emotion."[274] Sail power was so ingrained in naval identity that naval personnel, including line officers, were—and still are—called sailors. Stemming from the noun "sail" originally meaning to "travel on water in a ship by the action of wind upon sails," the term sailor means "one who sails."[275] In the mid-1800s sailors were still physically connected to sail technology because they still operated sails on ships. Beyond being the foundation for the common identifying term for naval personnel, the sight of sails instilled pride and gave meaning to the lives of the personnel controlling them. Replacing the technology at the core of the sailor tradition and identity threatened the foundations of the sailor identity. Consequently, naval personnel reacted by creating a dividing line between real and fake sailors, based on their experience or lack thereof on sail-powered vessels.

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[271] Matthew C. Perry was a renowned line officer in the 1850s. Griffis, *Matthew Calbraith Perry*, 151–52.

[272] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps,* 31.

[273] McBride, *Technological Change and the United States Navy: 1865-1945*, 12.

[274] Griffis, *Matthew Calbraith Perry*, 73.

[275] *Online Etymology Dictionary*, s.v. "sailor," accessed March 2, 2022, https://www.etymonline.com/word/sailor.

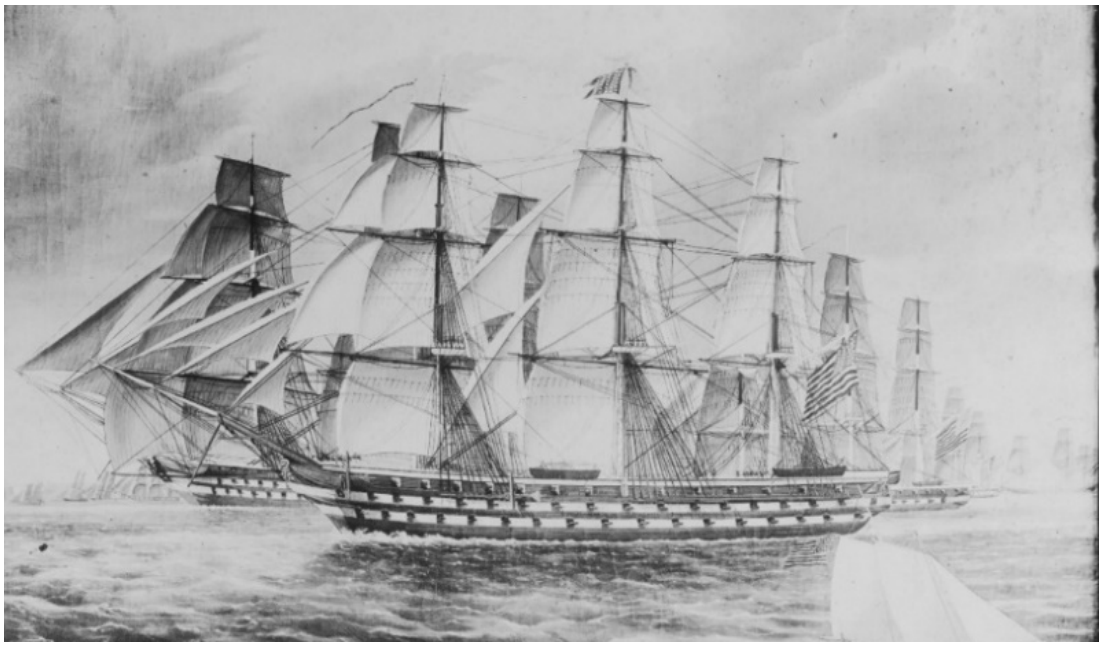

Figure 15. USS *North Carolina*[276]

2. Group Collective Action: Line Officers versus Engineers

Line officer group actions in the mid-1800s illustrate a tenet of social identity theory explored by Tajfel and Turner that "the mere awareness of the presence of an out-group is sufficient to provoke intergroup competitive or discriminatory response on the part of the in-group" because line officers used collective action to attempt to reduce engineer authority and remove engineers from the Navy altogether.[277] For instance, in 1878, line officers collected and sent funds to lobbyists in Washington to defend their "command prerogatives against the aggressive movement of the Corps of Engineers."[278] Two years later, 320 active duty and retired line officers of all ranks signed a letter addressed to the Secretary of the Navy arguing that staff officers, including engineers,

[276] Source: NH 54309 USS North Carolina (1818-1857) Foreground with USS Delaware (1820-1861) Left and Frigates Brandywine and Constellation," Naval Heritage and History Command, accessed February 23, 2022, https://www.history.navy.mil/content/history/nhhc/our-collections/photography/numerical-list-of-images/nhhc-series/nh-series/NH-54000/NH-54309.html.

[277] Mary Jo Hatch and Majken Schultz, eds., *Organizational Identity: A Reader* (Oxford, UK: Oxford University Press, 2004), 56.

[278] Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 67.

endangered "the whole fabric of the Navy, as an efficient military establishment" by encroaching "upon the authority of the Line officers."[279] To emphasize the hierarchy between the two groups, the line officers further stated that the "real root of the trouble lies deep in the discontent of the staff with their inevitable secondary importance to the organizing, commanding, military branch [line officers]."[280] Together these statements illustrate a discriminatory response by line officers, provoked by threats on their authority and fear for the survival of their group identity, against the out-group staff officers. Line officers perceived themselves as the essential officer group of the Navy because they were responsible for military actions like command and fighting the ships. Consequently, conflicts between individual line officers and engineers became a conflict between the two larger groups.

3. Result

As a result of Porter's executive orders and the continued clash of identities between line officers and engineers, the United States Navy installed inefficient equipment solely to support sail power and fell behind other navies in technological advancement. Some of the modifications made to benefit sail power, such as the implementation of two-bladed propellers, hurt vessel performance. In 1875, the Secretary of the Navy authorized the reinstallation of the four-bladed propellers because many reports from the fleet reported that the two-bladed propellers significantly reduced ship efficiency.[281] Though Mahan had originally rebelled against the idea of steam power, he was "also mortified by the post-war service's decline" evident in the Navy's disregard for steam power.[282] Other navies, like the French and British, took advantage of new technologies like steam engines to progress their fleet out of the sail era, surpassing the outdated American fleet in the late 1800s.[283]

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[279] Line Officers, "Letter to Secretary of the Navy," January 22, 1878, 3–4.

[280] Line Officers, 10.

[281] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 643.

[282] Robert L. O'Connell, *Of Arms and Men: A History of War, Weapons, and Aggression* (New York, NY: Oxford University Press, 1989), 214.

[283] Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 278.

Instead of focusing on developing technology to benefit the service's external missions, the Navy was stuck in an internal competition between old and new identities.

D. CONDEMNATION OF THE STEAMSHIP *WAMPANOAG*

Though the *Wampanoag* was the fastest steam ship in the world in 1869 and considered "faultless" by its commanding officer during sea trials, it was rejected and deemed unfit for naval use by line officers, delaying the transition to steam power in the Navy until the late 1800s.[284] The Navy Board on Steam Machinery's rejection of the *Wampanoag* in 1869 provides a specific case of line officers making a last effort to protect sail power despite the superior performance capabilities of steam engines.[285]

The *Wampanoag* (see Figure 16), designed by Navy Bureau of Engineering Chief Benjamin Isherwood, was built in the late 1860s to be a commerce raiding ship in line with the Navy's primary mission at the time.[286] It was meant to be the first in a class of similar ships. Before sea trials, the Board predicted that the ship would roll in bad weather and be hard to maneuver because of its longer length, larger displacement, and unusual deck proportions compared to standard sailing ship designs.[287] Instead, observers for the Secretary of the Navy stated that it was "remarkably steady, efficient, and easy" to handle.[288] And, three Chief Engineers, who participated in the sea trials, wrote in a report that "we are of opinion that it [the *Wampanoag*] is not to be equaled for speed or economy by that of any sea-going vessel of either the merchant or naval service of any country."[289] The *Wampanoag* outperformed earlier steam warships because it was capable of steaming at sixteen versus eight knots in rough seas with three times the horsepower and less coal consumption than the *Merrimack* built in 1862.[290] The *Wampanoag* was slightly faster

[284] Buhl, "Mariners and Machines," 703.

[285] Morison, Men, Machines, and Modern Times, 114.

[286] Morison, 114.

[287] Morison, 114–15.

[288] Morison, 115.

[289] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 567.

[290] Buhl, "Mariners and Machines," 708.

than the merchant ships, *City of Paris* and *Ville de Paris*, which were the fastest ships in the world at the time, clocked at fourteen and a half knots.[291] Despite this impressive performance, the Board labeled it "scarcely more than naval trash," removed it from active duty, and halted production of the rest of the class.[292]

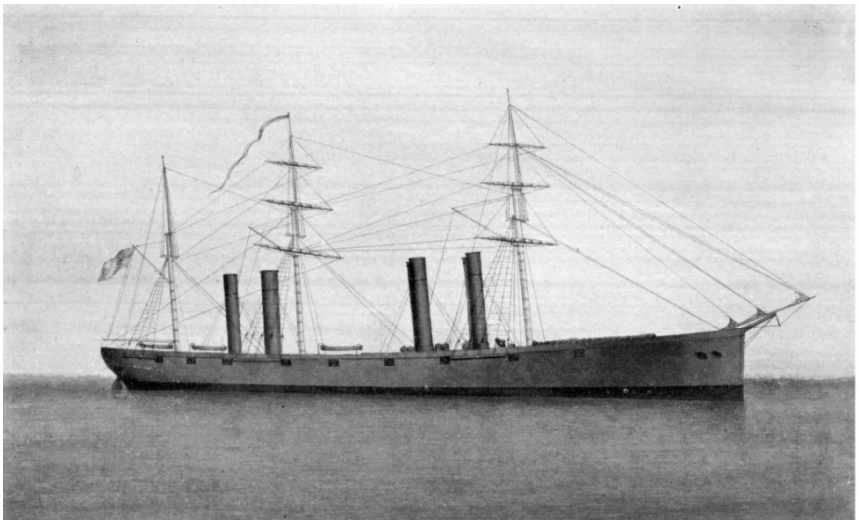

Figure 16. USS *Wampanoag*[293]

1. Traditional Line Officer Behaviors Challenged

Line officers of the sail-tradition, exemplified by the Board of Steam Machinery, feared the obsolescence of the tasks associated with their role as commanders of sail-powered vessels. The Board was chaired by Rear Admiral Louis Goldsborough, an old and respected line officer. Before evaluating the *Wampanoag,* the Board members wrote in a report to Congress that command of a steamship run by engineers was a "poor substitute

[291] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 568.

[292] Two engineers on the Board of Steam Machinery submitted a minority report stating their disagreement with the Board's overall decision. See: Bennett, 578; For the Board of Steam Machinery's report see: Department, United States Navy, *Annual Report of the Secretary of the Navy*, vol. 1411 (U.S. Government Printing Office, 1869), 207, https://congressional.proquest.com/congressional/docview/t47.d48.1411_h.exdoc.1_4?accountid=12702.

[293] Source: Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 551.

for the school of observation, promptness and command found only on the deck of a sailing vessel."[294] Sail power, as an art form, required constant manipulation and reconfiguration of sails to capture the wind in each moment.[295] Line officers learned how to use sails effectively through practice and experience.[296] Without sails, part of their identity was gone. Steam engines, on the other hand, required prior technical training and knowledge, which engineers not line officers had in the mid-1800s.[297] On a steamship, commanding officers did not directly control steam power as they did sail power. Since steam worked regardless of wind conditions, commanding officers no longer needed the skillset and expertise to manipulate the elements. Yet, that expertise was a large part of the skillset and identity learned by line officers.

According to identity theory, people compare their actions when occupying a role with the behaviors associated with that role to verify their perceived identity.[298] If their behavior does not match expectations, they may become dissatisfied with their role, withdraw from interacting in that role, or try to re-establish the legitimacy of their identity.[299] When line officers were confronted with a new set of behaviors and tasks related to steam power, their identity was no longer clear because it was built around tasks and behaviors needed on sail-powered vessels. Removing that skillset undermined their identity and perception of authority. Consequently, as detailed in previous sections, some line officers lashed out to reestablish the line officer identity.

2. Protecting the Line Officer Group

The *Wampanoag's* condemnation exemplifies social identity theory's prediction that an in-group will use any method possible to maintain and justify the status quo when

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[294] Originally from U.S. Document 1411 of the 41st Congress, 2nd Session Volume 1, Part 1. Referenced in: Morison, *Men, Machines, and Modern Times*, 114.

[295] McBride, *Technological Change and the United States Navy: 1865-1945*, 4.

[296] Alfred Thayer Mahan, *From Sail to Steam* (New York, NY: Harper & Brothers Publishers, 1907), 35–38.

[297] McBride, *Technological Change and the United States Navy: 1865-1945*, 4, 21.

[298] Stets and Burke, "Identity Theory and Social Identity Theory," 233.

[299] Burke and Stets, *Identity Theory*, 116, 159.

its status as the dominant group is challenged by an out-group.[300] The Board's decision followed a sentiment Porter had written in the same year stating that he and the line officer group wanted to "strip him [Isherwood] and the engineers of all honors" to "make them the most inferior corps in the Navy."[301] Though not the only reason why the *Wampanoag* was condemned, identity played an important role in the decision because of the threat steam represented to the power of the line officers as a group. In this case, the actions of a small group representing the interests of the line officer community rejected steam power, dampening the development of steamships within the Navy.[302]

3. Result

While other navies moved forward to ironclads and steam power, the American Navy, run by line officers, rejected new technology partially because steam power challenged the traditional individual and group identities of line officers. By the mid-1800s, American merchants used hundreds of steam vessels all over the world, yet the Navy resisted the implementation of steam power for two more decades.[303] The three ships the Navy authorized to be built in the 1870s were wooden and sail-powered.[304]

It was not until the Navy fell so far behind other navies that it reinvested in steam power development. In 1881, Secretary of the Navy, William Hunt, declared that action must be taken to modernize the Navy or else "it must soon dwindle into insignificance."[305] Two years later, in 1883, the Navy built its first steel steamships, with steam as the primary

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[300] Hatch and Schultz, *Organizational Identity*, 38.

[301] David Porter, "Letter to Surgeon Pinckney," Porter Papers, December 31, 1867, Library of Congress.

[302] See the following for a discussion on other factors taken into consideration by the Board such as budget concerns and the coal for ammunition tradeoffs: Buhl, "Mariners and Machines," 709–11.

[303] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps,* 16.

[304] Karsten*, The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 278.

[305] David Colamaria, "The Story of the New Steel Navy," The United States Navy, 2010, https://www.steelnavy.org/history/exhibits/show/steelnavy/introduction/story.

propulsion method.[306] The creation of the first battleships, *Maine* and *Texas* (see Figure 17), in the 1890s signaled the official transition from sail to steam power.[307] Arguably, the identity conflict lasted as long as it did in part because of the lack of military conflict in the mid-to-late 1800s. Though the Civil War's urgency propelled steam technology development, the end of the war saw a retreat to sail power because the lack of an external conflict allowed for internal identity conflicts to grow.

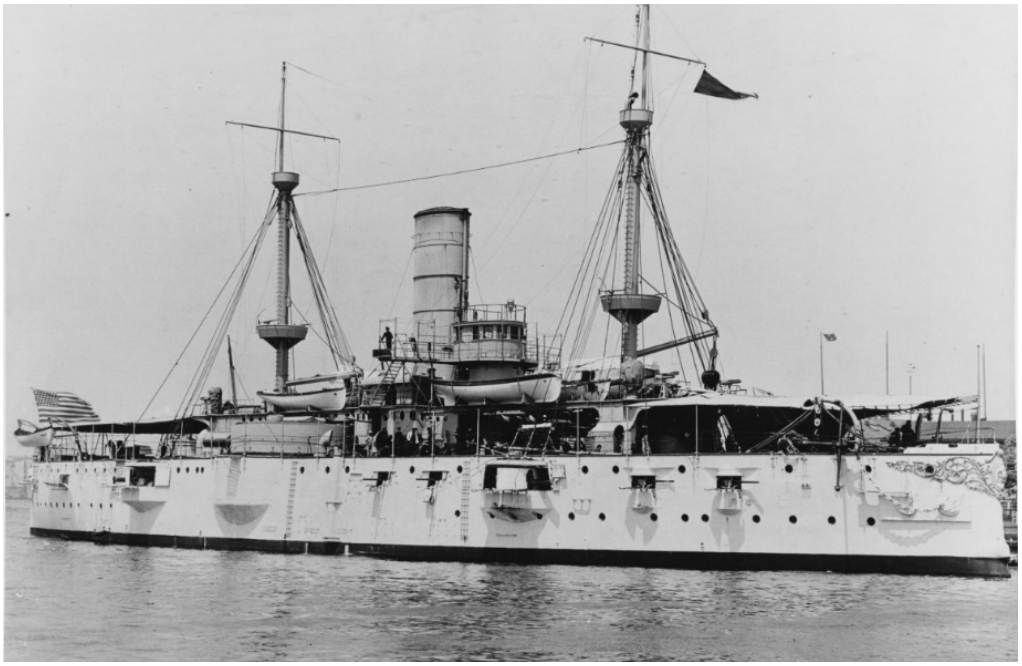

Figure 17. USS *Texas*[308]

[306] William H. Hunt, *Report of the Secretary of the Navy*, vol. 2016 (Washington, DC: U.S. Government Printing Office, 1881), 3, https://congressional.proquest.com/congressional/docview/t47.d48.2016_h.exdoc.1_9?accountid=12702.

[307] Naval History and Heritage Command, "Sail to Steam Propulsion," Naval History and Heritage Command, last modified April 12, 2019, https://www.history.navy.mil/browse-by-topic/communities/surface/steam.html#:~:text=Over%20the%20years%2C%20experimentation%20of%20steam%20propulsion%20occurred,1890s%20with%20the%20first%20battleships%2C%20Maine%20and%20Texas.

[308] Source: "NH 74105 USS Texas," Naval History and Heritage Command, accessed March 2, 2022, https://www.history.navy.mil/content/history/nhhc/research/publications/documentary-histories/united-states-navy-s/joint-operations-san/illustrations/uss-texas.html.

IV. CULTURE AND ORGANIZATIONAL CHANGE MODELS IN THE SAIL-TO-STEAM TRANSITION

This chapter looks at how deeply ingrained organizational identity and culture based on one technology affects the organization's transition to a different technology. Specifically, this chapter analyzes the individual and group identity factors and scenarios from Chapter III within the context of Bridges' and Rogers' organizational transition models to identify when in the transition people within the naval organization actively resisted new technology and why the technology characteristics prompted resistance, slowing down the implementation of that technology. All three events discussed in Chapter III (1866 and 1870 changes to the officer corps, 1860s executive orders reinforcing sail power, and the condemnation of the *Wampanoag*) exemplify individual reactions that are part of Bridges' first phase. Because the U.S. Naval Academy was the primary educational facility for line officers, this section also discusses the history of sail and steam engineering instruction at the school to show which technologies were taught as part of naval culture. The Naval Academy, slow to incorporate and keep engineering programs, indoctrinated line officers into the sail-based system. This case study shows when and how individual identity as a product of organizational identity and culture can produce resistance to change within the organization.

A. BRIDGES' TRANSITION MODEL

The three scenarios discussed in Chapter III illustrate individual resistance to change as predicted by Bridges in the letting go phase of his model (see Figure 18) because line officers resisted letting go of the old identity.[309] Between the fluctuations in the size of the officer corps in 1866 and 1870, a subsequent decrease in available promotions, and the higher number of postwar versus prewar engineers, line officers were afraid for their careers.[310] The increase in steam-powered vessels during the Civil War threatened to change or replace the sail-based line officer identity. According to Bridges, people resist

[309] Bridges, *Managing Transitions*, 5.

[310] Buhl, "Mariners and Machines," 725.

change because they want to "protect their world and the meaning and identity they got from it."[311] In this case, line officers felt their world was slipping away as engineers and steamships increased in the Navy. The line officer job focused on commanding sailors and manipulating sails to maneuver and engage an enemy ship. Some line officers resisted the reduction to their authority because steam power removed their control over the propulsion system and gave it to engineers.

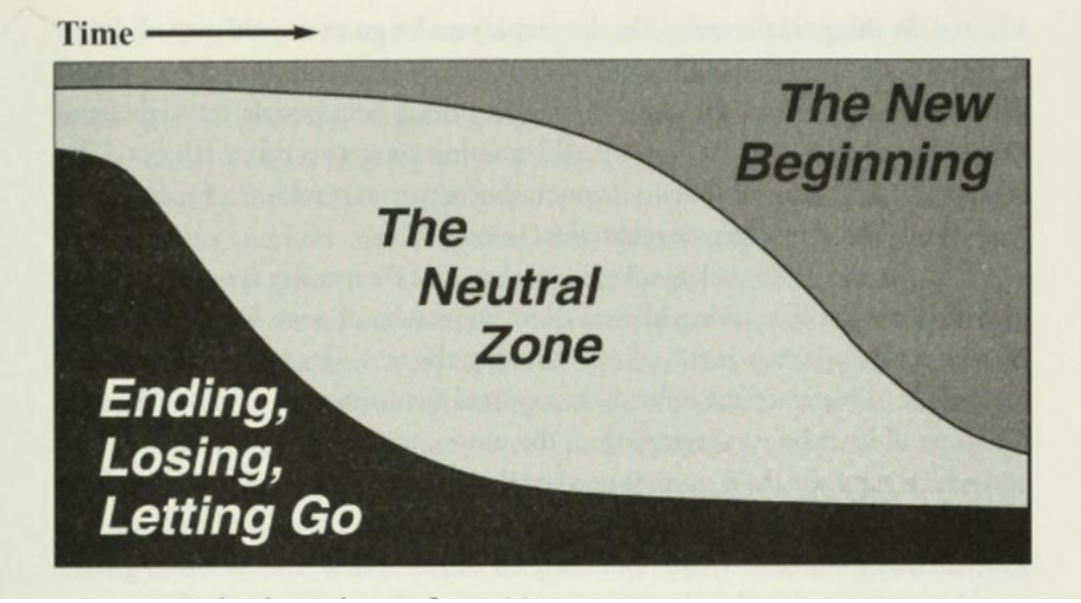

Figure 18. Bridges' Transition Model[312]

David Porter's executive orders, in the 1860s, mandating sail as the primary population method even after steam power had been used throughout the Civil War, exemplify the ensuing resistance to changes to the line officer identity. According to Bridges, resistance to change often manifests as resentment and "foot-dragging or sabotage."[313] Porter's orders, mandating that all ships had to have sail propulsion inhibited steam power development, institutionalized reluctance to accept steam power, and required

[311] Bridges, *Managing Transitions*, x.

[312] Source: Bridges, 5.

[313] Bridges, 16.

time and money to modify vessels.[314] The orders even resulted in rework because they required any four-bladed propellers removed and replaced with two-bladed propellers to complement sail power. However, the propellers were later swapped back because the two-bladed ones were inefficient.[315]

The Board of Steam Machinery's condemnation of the *Wampanoag* in 1869 is a specific example of the sabotage possible when individuals resist losing their old identity. Despite the *Wampanoag*'s superior speed performance compared to both naval and commercial vessels of the time as well as its smooth handling and maneuvering characteristics, the Board dismissed it and the rest of the vessels in its class, successfully delaying the production of more steam ships until the 1880s.[316] Not only was steam power development halted in the Navy, but the Navy fell behind such other navies as the French and British because those navies adopted steam power and other technologies faster.

Together, these events illustrate Bridges' statement that "it's the process of letting go that people resist" because so much of the line officer identity and meaning was attached to sail power and the mythology around it—and they did not want to let go.[317] Without sails, individual identity became ambiguous, separated from its foundation, and left line officers scrambling to retrieve the pieces of their old identity. According to Bridges, in the letting go phase, the organizational leaders making the change must acknowledge and sever the identities and meanings connected to the old technology before expecting people within the organization to adopt and use the new technology.[318] Specifically he recommends that an organization should describe the transition and its possible impacts in detail, talk about the change openly, compensate for the perceived losses, communicate constantly to reduce confusion about what is and is not changing, and emphasize how the transformation is

[314] United States Navy Department, *General Orders and Circulars Issued by Navy Department from 1863 to 1887,* 82–84.

[315] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 639–43.

[316] Bennett, 551–68.

[317] Bridges, *Managing Transitions*, 15–16.

[318] Bridges, 7.

consistent with underlying values and beliefs.[319] Consequently, the organization has to recognize, acknowledge, and manage loss at the individual level to minimize resistance.

B. ROGERS' MODEL APPLICATIONS

Many line officers adopted steam power quickly and praised it, as part of what Rogers calls the early adopter group, including Commodore Matthew C. Perry, often called the father of the steam navy because of his avid support for steam power in the early-to-mid 1800s.[320] In 1837, he commanded the second naval steamship, *Fulton II*, and tried to mitigate conflict between line officers and engineers by recognizing the engineers as equals to the line officers and moving them into the officers' quarters.[321] However, Perry's efforts and beliefs were not mirrored across the entire fleet.[322]

Instead, a segment of line officers, embodying Rogers' late adopter and laggard categories (see Figure 19), actively resisted steam power in the mid- to late 1800s, even as other line officers readily accepted it. Based on Rogers' definition, the resistant line officers were late adopters because they approached the innovation of steam power "with a skeptical and cautious air" refusing to adopt it "until most others in their [social] system [had] already done so."[323] Many of them also fit into Rogers' laggard category because of their attachment to the past through traditional values and beliefs connected to sail power.[324] They were so attached to the identity and meaning associated with sail technology that they rejected steam power.

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[319] Bridges, 23–36.

[320] "Perry, Matthew Calbraith," Naval History and Heritage Command, last modified January 30, 2020, https://www.history.navy.mil/content/history/nhhc/research/library/research-guides/z-files/zb-files/zb-files-p/perry-matthew-c.html.

[321] Ringle, *Life in Mr. Lincoln's Navy*, 7.

[322] See Chapter III Sections B.1 and C.2 for examples of line officers who did not support steam power or engineers.

[323] Rogers, *Diffusion of Innovations*, 284.

[324] Rogers, 284.

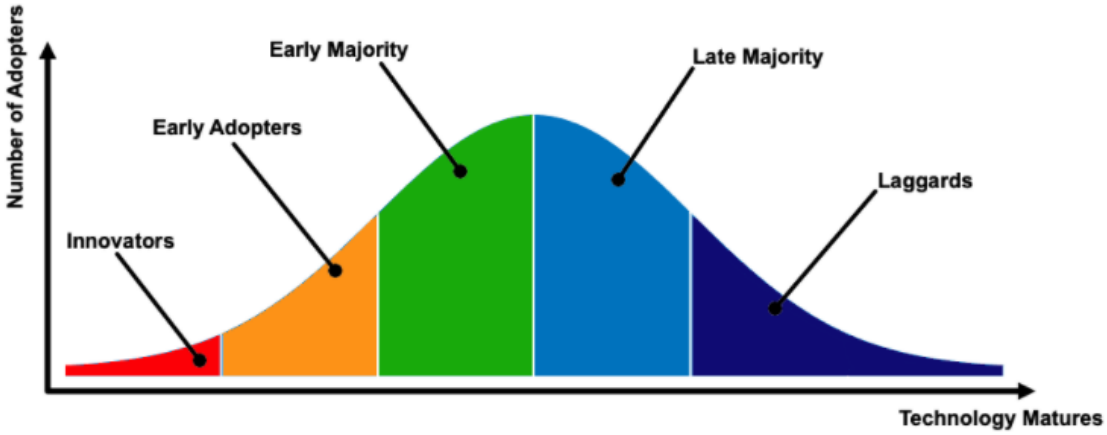

Figure 19. Adopter Categories[325]

Resistant line officer actions fit into two of the three rejection categories Rogers identifies: passive rejection and discontinuance.[326] The condemnation of the *Wampanoag* exemplifies passive rejection because the Board of Steam Machinery set out to evaluate the ship and render an opinion on whether it should stay in the Navy after already deciding not to adopt it.[327] Perhaps more urgently, discontinuance, per Rogers, is rejection of an already adopted innovation.[328] Porter's executive orders mandating the use and installation of sails over steam power was an act of discontinuance. He actively rejected steam power's dominance after steam engines were already used, installed, and performing well on some naval vessels.[329] Though steam engines were not removed from ships, they were relegated

[325] Source: Darya Sinusoid, "Crossing the Chasm: Technology Adoption Life Cycle," *Shortform* (blog), October 20, 2021, https://www.shortform.com/blog/technology-adoption-life-cycle-chasm/.

[326] Rogers, *Diffusion of Innovations*, 178.

[327] For information on rejection see: Rogers, 178; For information on the Board of Steam Machinery's predisposed opinion see: Elting E. Morison, *Men, Machines, and Modern Times* (Cambridge, MA: MIT Press, 1966), 114–15.

[328] Rogers, *Diffusion of Innovations*, 178.

[329] For a description of Matthew Perry's successful use of steamships in the Mexican American War see: Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 88–99.

as the backup system to be used only in an emergency despite their wide use in the Civil War.[330]

Based on Rogers' five-step model for innovation in organizations, rejection, as demonstrated by the line officers in this case study, often appears in the third and fourth steps: redefinition and clarification (see Figure 20). In the redefinition stage an organization is supposed to redefine both itself and the innovation to fit together as the innovation becomes widespread.[331] Rogers further argues that disruptive innovations, defined as those that "represent a new paradigm for carrying out some task" are more likely to create resistance because they make the people within the organization more uncertain about their future and how to use the new technology.[332]

The line officer's reaction to steam power exemplifies how uncertainty in this stage leads to resistance because line officers were unsure how to define themselves without sails. On a steamship, the engineer, instead of the line officer, had the specialized knowledge needed to manipulate the new propulsion system, which challenged the role of the line officer commanding the ship.[333] Under sail power, the commanding officer not only commanded personnel but oversaw both maneuvering and fighting the ship.[334] Under steam power, the commanding officer no longer directly controlled propulsion.[335] Consequently, some line officers, uncertain about what their role and tasks were with the new technology, reacted by resisting steam power.

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[330] United States Navy Department, *General Orders and Circulars Issued by Navy Department from 1863 to 1887*, 82–84.

[331] Rogers, *Diffusion of Innovations*, 421.

[332] Rogers, 426.

[333] McBride, *Technological Change and the United States Navy: 1865-1945*, 4,21.

[334] McBride, 13–14; For line officer opinions see: Line Officers, "Letter to Secretary of the Navy," January 22, 1878, 11, https://www.navyhistory.org/wp-content/uploads/2013/04/22Jan1878ltrtoSECNAV.pdf.

[335] McBride, *Technological Change and the United States Navy: 1865-1945*, 21.

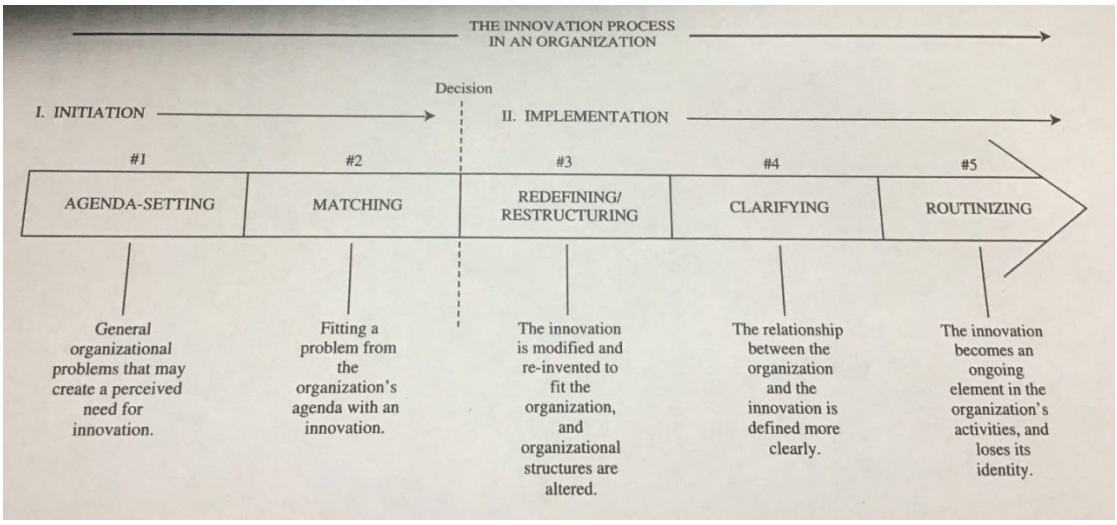

Figure 20. Rogers' Five Step Organizational Innovation Process[336]

Additionally, line officers' actions demonstrate how leadership failures in managing the clarification stage can lead to resistance. In the clarification stage, the framing and social construction surrounding the new technology is solidified as people within the organization figure out how the technology works and how it affects them.[337] In the sail-to-steam transition, line officers used collective action to resist steam power. For instance, the 1876 letter sent to the Secretary of the Navy by more than 300-line officers included concerns about how steam power changed both the social and authority structures on ships, especially between commanding and executive officers. They were also concerned that the relationship change weakened the Navy as a whole.[338] Thus, line officers resisted steam power because they perceived it as changing the social structures they were used to and were unsure how they fit into the organization without sail power.

Part of this resistance stemmed from characteristics of steam power itself that were complex compared to sail power and incompatible with old values and experience. Compatibility and complexity are two of the five factors of innovation that Rogers

[336] Source: Rogers, *Diffusion of Innovations*, 421.

[337] Rogers, 428.

[338] Line Officers, "Letter to Secretary of the Navy," January 22, 1878, 10–11.

identifies as predictors of adoption rates.[339] Between a lack of engineering education from the Naval Academy and a (corresponding) paucity of experience on steamships, some line officers did not have the knowledge and skillset to operate or even understand steam engines.[340] Furthermore, sail power was perceived as synonymous with the naval aristocracy surrounding the line officer community, while steam power challenged the perceived clean beauty of sails and power of their operators.[341] Line officers, embedded in the sail culture from their days at the academy, viewed steam engines as turning ships into machines controlled by the unseen engineers belowdecks. Therefore, because of the high complexity and low compatibility of steam compared to sail power, line officers resisted and actively rejected adopting steam power.

C. CULTURE AND THE NAVAL ACADEMY

As the primary entry-point facility for line officers into the Navy in the mid- to late 1800s, the Naval Academy molded the cultural foundation of the service, and line officers specifically. Once established in 1845, the Naval Academy was the only way a line officer could be commissioned, except for the less than one percent who transitioned from enlisted to officer ranks between 1862 and 1870.[342] Because admission to the academy required a nomination from a Congressman or the Secretary of the Navy, candidates needed political influence to receive an appointment and be accepted, which limited the number of potential applicants to upper-class families with money and political connections.[343] The school's curriculum, taught during students' the formative young adult years, established the knowledge, skillset, and tradition of the line officer graduates.

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[339] Compatibility and complexity are the most applicable to this case study because that is where the identity and cultural resistance stemmed from. The other three are trialability, observability, and relative advantage. See Chapter I Section D for a description of all five factors.

[340] McBride, *Technological Change and the United States Navy: 1865-1945*, 21.

[341] Griffis, *Matthew Calbraith Perry*, 73; Lynch, Naval Life, 132; Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 70–71.

[342] William M. McBride, *Technological Change and the United States Navy: 1865-1945* (Baltimore, MD: Johns Hopkins University Press, 2000), 21; For more information about line officer recruitment sources including enlisted personnel see: Peter Karsten, *The Naval Aristocracy; the Golden Age of Annapolis and the Emergence of Modern American Navalism.* (New York, NY: Free Press, 1972), 13.

[343] Karsten, *The Naval Aristocracy: The Golden Age of Annapolis and the Emergence of Modern American Navalism*, 6.

The Naval Academy was slow to introduce steam engineering into the curriculum and slower still to create a program to produce engineers as well as line officers.[344] After Gideon Wells, Secretary of the Navy, wrote in the 1864 Annual Report that he foresaw having twice as many officers "capable of fighting and running the vessels" by combining engineers and line officers into one group, Congress enacted legislation stating that the Naval Academy could form a separate class of cadet engineers.[345] Instead of starting the program right away, however, the Navy sent two assistant engineers to the academy to teach philosophy in 1864.[346] The following year, the school established the Steam Engineering Department to teach midshipmen the basics of marine engineering, followed by the creation of a separate building and a model steam engine (see Figure 21).[347] While first- and second-class midshipmen were required to take classes in such mechanical subjects as optics, fluid mechanics, and magnetism in the 1860s, only one term included steam engines; midshipmen could not specialize in steam engineering until 1871.[348] Yet, during the same years, midshipmen had seamanship classes every term.

[344] McBride, *Technological Change and the United States Navy: 1865-1945,* 21–24.

[345] United States Navy Department, *Annual Report of Secretary of Navy*, xxxviii.

[346] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 660. There were two 2nd assistant engineers already teaching philosophy at the academy when two more were sent. See: "Official Register of Officers and Midshipmen of U.S. Naval Academy" (Department of the Navy, January 1, 1862), 25–28, ProQuest.

[347] Bennett, 660.

[348] For the 1871 introduction see: Travis Chapman, "History of the Mechanical Engineering Department," last modified July 6, 2021, https://www.usna.edu/MechEngDept/About_Our_Department/History.php; For curriculum information see: Naval Academy, "Official Register of Officers and Midshipmen of U.S. Naval Academy." https://congressional.proquest.com/congressional/result/congressional/congdocumentview?accountid=12702&groupid=100340&parmId=17EDA3A736E&rsId=17EDA36597E; Naval Academy, "Annual Register of U.S. Naval Academy" (Department of the Navy, November 1, 1864), 29–32, https://congressional.proquest.com/congressional/result/congressional/congdocumentview?accountid=12702&groupid=100340&parmId=17EDA36D4C7&rsId=17EDA36597E#1507.

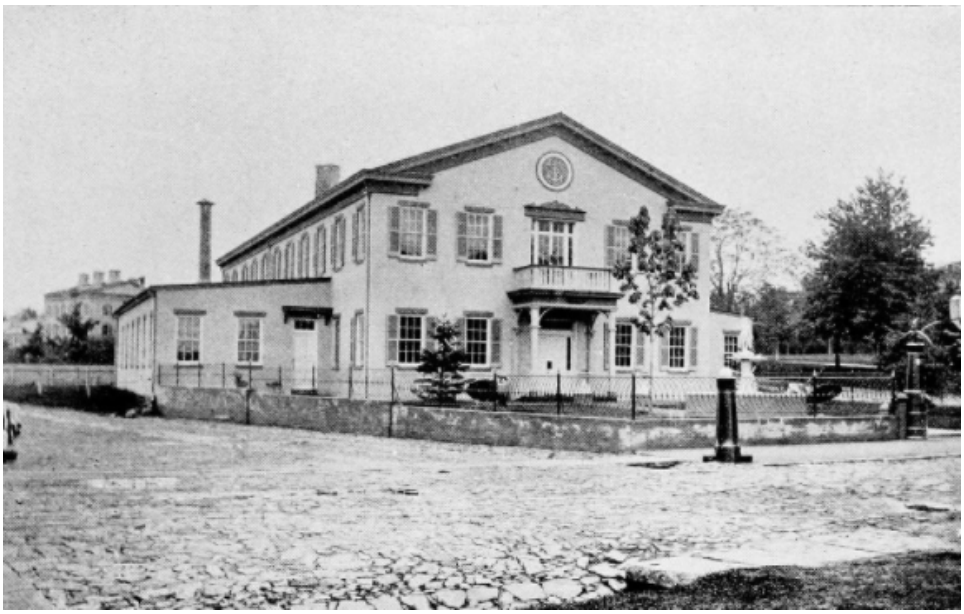

Figure 21. Naval Academy Steam Engineering Building in 1878[349]

The life of the cadet engineering program modeled the pendulum-like implementation of steamships; that is, it stopped and started several times between 1866 and 1882. Between 1866 and 1867, only four applicants were accepted as cadet engineers, partially because it was difficult to find 18-year-old men who already had the required two years of mechanical experience.[350] Also in 1866, the academy recruited 16 graduates from engineering colleges in the Northeast to commission as third assistant engineers and attend a post-graduate program at the academy in marine engineering.[351] However, this program was not repeated and, in fact, the cadet engineering program ended in 1868 because only two of sixteen cadet engineers graduated.[352] At Engineer-in-Chief King's urging in 1871, the Naval Academy reinstated the cadet engineering program for the final time.[353] Then

[349] Source: Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 661.

[350] Mechanical experience was defined as having at least two years in steam machinery manufacturing. Bennett, 665.

[351] Bennett, 666.

[352] Bennett, 668.

[353] Bennett, 683.

in 1882, cadet engineers were combined with the naval line midshipmen to be naval cadets who would specialize after graduation to fulfill line and engineering billets.[354]

Overall, the Naval Academy reinforced the sail-based culture throughout the mid-1800s; midshipmen had little interaction with engineers or steam power compared to sail power at the Naval Academy. The sixteen 1866 engineering graduates lived off-campus, trained separately, and were not part of the cadet company.[355] Even when the cadet engineering program was reestablished in 1871, the program was limited to 16–25 selectees per year, so cadet engineers equaled, at most, about 16 percent of the student body.[356] Though there were classes in steam engineering, Bennett argued that the "older art of seamanship still retain [ed] a prominent place in the curriculum of the school" through the end of the 19th century.[357] Even today, in the age of nuclear power, the sailing tradition remains an integral part of the required curriculum. For instance, all new midshipmen participate in sail training during Plebe Summer at the Naval Academy.[358] Though the Navy has moved on to new technology, it has not fully let go of the old sail-based identity.

[354] Bennett, 689.

[355] Bennett, 666.

[356] Naval Academy, "Annual Register of U.S. Naval Academy" (Department of the Navy, January 1, 1871), 17,39, https://congressional.proquest.com/congressional/docview/t66.d71.n1205-14?accountid=12702; Naval Academy, "Annual Register of U.S. Naval Academy" (Department of the Navy, January 1, 1872), 15,39, https://congressional.proquest.com/congressional/docview/t66.d71.n1205-15?accountid=12702.

[357] Bennett, *The Steam Navy of the United States: A History of the Growth of the Steam Vessel of War in the U. S. Navy, and of the Naval Engineer Corps*, 660.

[358] W.E. Carter, *U.S. Naval Academy Sailing Programs*, USNA Instruction 1500.5 (Annapolis, MD: United States Naval Academy, 2018), 2, https://www.usna.edu/AdminSupport/_files/documents/instructions/1000-1999/USNAINST_1500.5_U.S_Naval_Academy_Sailing_Program.pdf.

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V. PILOT IDENTITY AND CULTURAL FACTORS IN THE CREWED-TO-UNCREWED TRANSITION

Like chapters III and IV, this chapter explores the identity and cultural factors involved in naval aviation's current transition from crewed to uncrewed aircraft. Resistance to the transition will inhibit the effectiveness of the naval forces as a whole and reduce their ability to win in a conflict. In this moment of rapid technological change, similar to the catalysts of the Civil War, naval aviation can benefit from adopting technology faster than peers or adversaries if the pilot identity problem is addressed. As machines assume more responsibility within the cockpit, and naval aviation and modern warfare evolve, the role of the human pilot or operator will continue to change and be redefined. This power transition implies changes within naval aviation identity, culture, and the centrality of the crewed aircraft pilot.

A. PILOT ROLE AND AUTHORITY ENDANGERED

The increase in uncrewed aircraft within naval aviation threatens the traditional pilot identity rooted in the physical aircraft because the pilot role is being removed from the cockpit and directly operating aircraft. According to Associate Dean of Academics at the Naval War College and former Air Force pilot, Timothy Schultz:

> the traditional paradigm of manned flight places the pilot at the center of the aviation universe…pilot identity orbits around this assumption. Modern technology upends this pilot-centric view of flight, displacing the pilot and locating a new center: the machine.[359]

Though aircraft have been slowly automated over time giving the machine more responsibility for aircraft operation, removing pilots from the physical aircraft is a visible indicator that the traditional pilot identity is becoming obsolete.[360] Like the line officer

[359] Timothy Schultz, *The Problem with Pilots: How Physicians, Engineers, and Airpower Enthusiasts Redefined Flight* (Baltimore, MD: Johns Hopkins University Press, 2018), 159.

[360] Vincent Boulanin and Maaike Verbruggem, *Mapping the Development of Autonomy in Weapon Systems* (Solna, Sweden: Stockholm International Peace Research Institute, 2017), 72, https://www.sipri.org/sites/default/files/2017-11/siprireport_mapping_the_development_of_autonomy_in_weapon_systems_1117_1.pdf.

and engineer example, the literal and figurative removal of the pilot from the cockpit exemplifies identity theory's conclusion that identities revolve around specific resources and contexts.[361] People are unable to verify their role-related identity when the resources and context do not match their expectations.[362] Inability to verify identity can result in dissatisfaction, negative emotions, withdrawal from the role, and attempts to reestablish the identity.[363] Removed from the cockpit, or even left inside an automated cockpit, pilots are not evaluated on their stick-and-rudder skills but on their ability to manage subsystems, analyze information, and coordinate groups of aircraft.[364] Therefore, uncrewed aircraft pilots are not directly operating the aircraft, which contradicts pilot role expectations.

Like line officers in the 1800s, pilots are psychologically linked to a physical object because of their name. The dictionary definitions of pilot reinforce the connection between pilots and operating the flight controls of an aircraft. For instance, the Webster dictionary defines pilots as "a person who flies or is qualified to fly an aircraft or spacecraft," while Lexico states a pilot is "a person who operates the flying controls of an aircraft."[365] According to these definitions, a pilot is uniquely qualified to manipulate the flight control surfaces of an aircraft through the controls.

Naval aviation recruitment sites connect the pilot identity to specific behaviors like instinctual actions, physically operating an aircraft, and understanding both nature and machines. For instance, the Navy's information website promotes these perceptions when it describes fighter pilots as being able to "persevere through the toughest challenges" and missions that are "among the most daring and important" by using unique and highly honed skill sets.[366] The fixed-wing and helicopter pilot job descriptions, while less dramatic, still

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[361] Burke and Stets, *Identity Theory*, 107–8.

[362] Burke and Stets, 108.

[363] Burke and Stets, 159, 164.

[364] Schultz, *The Problem with Pilots: How Physicians, Engineers, and Airpower Enthusiasts Redefined Flight,* 159–61.

[365] *Lexico Dictionaries*, s.v. "pilot," accessed April 5, 2022, https://www.lexico.com/en/definition/pilot; *Merriam Webster*, s.v. "pilot," accessed April 5, 2022, https://www.merriam-webster.com/dictionary/pilot.

[366] Navy Recruiting Command, "Fighter Pilot," America's Navy, accessed April 5, 2022, https://www.navy.com/flynavy.

emphasize creativity, versatility, and specialized training as the foundation for becoming an effective pilot.[367] Based on these descriptions, pilots are identified by a combination of specialized training and unique operational experience where they know how to operate an aircraft while understanding and maneuvering in the natural environment and while possibly engaging adversaries.

Similar to line officers and engineers in the mid-1800s, pilots of crewed and uncrewed aircraft are separated by different rank structures. All crewed pilots are unrestricted line officers, meaning they are eligible to command seagoing or warfighting units, which are highly prized billets needed for further promotion.[368] Unrestricted line officers hold the ranks of ensign to admiral. Meanwhile, not all uncrewed pilots are unrestricted line officers. Those training to operate the newest uncrewed aircraft, the MQ-25 Stingray, are warrant officers.[369] Unlike unrestricted line officers, warrant officers are not eligible for seagoing command.[370] Unrestricted line officers are higher ranked than warrant officers, thus an automatic hierarchical relationship arises between crewed and uncrewed pilots. The Stingray pilots are significant to this case study because, while they are initially restricted to operating Stingrays, they will slowly spread to other uncrewed aircraft like the Triton, replacing some of the unrestricted line officers.[371]

According to *The Naval Officer's Guide,* warrant officers "follow career paths that make use of their specific areas of expertise," usually in a specialized technical area.[372] Uncrewed aircraft pilots, officially called aerial vehicle operators, are meant to be

[367] Navy Recruiting Command, "Fixed Wing Pilot," America's Navy, accessed April 5, 2022, https://www.navy.com/careers/fixed-wing-pilot; Navy Recruiting Command, "Helicopter Pilot," America's Navy, accessed April 5, 2022, https://www.navy.com/careers/helicopter-pilot.

[368] Lesa A. McComas and J.D. Kristensen, *The Naval Officer's Guide*, 13th ed. (Annapolis, MD: Naval Institute Press, 2019), 217.

[369] Navy Personnel Command, "Applicant Information."

[370] McComas and Kristensen, *The Naval Officer's Guide*, 219.

[371] Navy Personnel Command, "Applicant Information."

[372] McComas and Kristensen, *The Naval Officer's Guide*, 219; For more information of naval officer categories see: Navy Personnel Command, *Manual of Navy Officer Manpower and Personnel Classifications: Major Code Structures*, vol. 1, 2 vols., NAVPERS 15839I (Washington, DC: Department of the Navy, 2022), https://www.mynavyhr.navy.mil/Portals/55/Reference/NOOCS/Vol1/Entire_Manual_I_79_rev1_Apr22.pdf?ver=oJspuWBsfMXgPGDaFYs-sA%3d%3d.

uncrewed aircraft subject matter experts. As uncrewed aircraft technology develops, so does the skill set required to operate them. According to the factsheet on this new designator, the Navy decided to make aerial vehicle operators warrant officers because "the complexity in operating and performing its [Stingray] mission from a carrier requires specialists rather than pilots from other type-model series."[373] Instead of working toward command billets, they will spend their careers honing their skills in operating uncrewed aircraft starting with the MQ-25 Stingray.[374]

Once again, just like line officers and engineers, the distinction between crewed and uncrewed aircraft pilots confuses who has authority over aircraft. Akin to line officers of the 1800s, the crewed pilot role is not only linked to physically operating a piece of technology but to the authority endowed by their rank. The uncrewed pilot role, like the engineer, correlates to their specialized job as operators of uncrewed aircraft. While the traditional pilot role is based on specialized knowledge and understanding of aircraft operation and tactics, the rationale for making aerial vehicle operators warrants implies that aerial vehicle operators are going to be more proficient experts than traditional pilots.[375] In the MQ-25 Stingray program, the aerial vehicle operator threatens the crewed pilot identity by assuming authority over a category of aircraft that crewed pilots cannot operate and becoming specialists in aircraft operation.

B. PILOTS AND AERIAL VEHICLE OPERATORS: IN-GROUP AND OUT-GROUP

The potential conflict between crewed and uncrewed pilots demonstrates how the in-groups and out-groups outlined in social identity theory are created. In this case, crewed pilots, established for a century, are the in-group while the new aerial vehicle operators are the out-group. According to social identity theory, language naturally creates psychological divisions because category labels automatically include some members while excluding

[373] Navy Personnel Command, "Applicant Information."

[374] Navy Personnel Command, "Applicant Information."

[375] Navy Personnel Command, "Applicant Information."

others.[376] Naval aviation created the foundation for this divide by separating pilots into two categories: naval aviators and aerial vehicle operators. Crewed pilots are officially designated Naval Aviators while uncrewed pilots, especially the new and future Stingray operators, are designated Aerial Vehicle Operators.[377] Though the description of both designators includes flying aircraft, the jobs are distinguished based on whether the human is inside the cockpit while flying.[378] According to Billig, all that is needed for intergroup conflict is the "mere existence of an outgroup" because groups inherently want to compete as soon as another one appears.[379] Moreover, friendly intergroup competition can morph into hostile conflict especially if there is no imminent external threat to the competing groups.[380] Separating pilots into warrant and unrestricted line officers creates an automatic division that encourages uneven competition over skillsets, expertise, and dominance within the naval aviation hierarchy.

Adding aerial vehicle operators actually creates a third group within naval aviation, further challenging the group dynamics within the service. Naval aviation already had two competitive groups that have a history of conflict: naval aviators and naval flight officers. In the 1960s, when the Navy created the new designator as an evolution of the naval flight observer, naval flight officers were not allowed to command squadrons, aviation schools, and aircraft carriers because the Navy viewed them as unqualified.[381] Despite their designation as unrestricted line officers and tactical and administrative qualifications, they were considered unfit to control aviation commands because they did not operate aircraft

[376] Billig, *Social Psychology and Intergroup Relations*, 326, 338.

[377] Navy Personnel Command, *Manual of Navy Officer Manpower and Personnel Classifications: Major Code Structures*.

[378] Navy Personnel Command, 1:A-7, A-20.

[379] Billig, *Social Psychology and Intergroup Relations*, 311, 341.

[380] Billig, 308–12.

[381] For information on command restrictions see: Stephen F. Loftus, "Career Development for the Naval Flight Officer," *Proceedings*, May 1, 1968, https://www.usni.org/magazines/proceedings/1968/may/career-development-naval-flight-oflicer; For the evolution and development of naval flight observers to naval flight officers see: Roy A. Grossnick, *United States Naval Aviation, 1910-1995*, 4th ed. (Washington, DC: Naval Historical Center, 1997), 662–66.

controls.[382] According to Lieutenant Commander Stephen Loftus, a naval flight officer in the 1960s, "the back seat that the Flight Officer takes in an aircraft becomes symbolic, for, from a career standpoint, he can never fly as high and as far as the Aviator" because they were excluded from prized command billets.[383] It was not until 1970, six years after the Navy created naval flight officers, that the United States Code was changed, allowing them to hold the same command billets as naval aviators.[384] Like the general orders Admiral Porter issued in 1869 mandating sail over steam power, this example illustrates how the Navy uses the law to formally encode hierarchical relationships.[385] The naval flight officer example demonstrates how entrenched naval aviators are within the service, and the potential career and relationship ramifications of introducing a separate group within the community. Not only might naval aviators conflict with aerial vehicle operators, but the conflict with naval flight officers could be reignited as naval aviators perceive a loss of authority. By creating a third group, naval leadership demonstrated its failure to learn from the troubles that attended the introduction of naval flight officers in the 1960s.

Furthermore, the groups within the Navy and naval aviation are distinguished by markers, such as flight jackets and special breast insignia. Under social identity theory, group members are connected to each other, and distinguished from other groups, by shared symbols.[386] In the Navy, aviation personnel including pilots, naval flight officers, flight surgeons, aerospace psychologists and physiologists, and enlisted aircrewmen are authorized to wear a brown leather flight jacket with certain uniforms in the tradition of

[382] Loftus, "Career Development for the Naval Flight Officer."

[383] Loftus.

[384] Public Law 91-198, 10 U.S.C. § 5942 (1970), https://uscode.house.gov/statviewer.htm?volume=84&page=15; While, six years may not seem like a long time, the ancestors of naval flight officers: naval flight observers had been around since 12 July 1921. See the following for more detail: Grossnick, *United States Naval Aviation, 1910-1995*, 662.

[385] See Chapter III Section C for a description of the general orders. To see the formal coded general orders see: United States Navy Department, *General Orders and Circulars Issued by Navy Department from 1863 to 1887*, 82–84.

[386] Tajfel, *Social Identity and Intergroup Relations*, 87–88.

aviators from the early 20th century.[387] The jackets distinguish the aviation community from other groups within the Navy such as surface and submarine warfare. These jackets symbolize pilot and aircrew identity so much that when surface warfare officers were authorized similar black jackets in 2020, some members of the aviation protested, claiming that the black jackets challenged and obscured the uniqueness of the aviation jackets.[388]

Within naval aviation, the three main aviation groups, naval aviator, naval flight officers, and aerial vehicle operators, are distinguished by different breast insignia symbolizing their designator and unique skillset.[389] More commonly called "wings of gold" these insignia not only prove individual accomplishment but indicate to which group a person belongs.[390] Created in 1917 to distinguish mimic the Army's pilot identification badges, naval aviator wings (see Figure 22) evolved into the gold device used today to indicate completion of flight school and official designation as a naval aviator.[391] Naval flight officer wings formally distributed in 1968, are similar yet just different enough to distinguish from naval aviator wings (see Figure 23).[392] Though aerial vehicle operators fly aircraft, the Navy decided to create a separate device similar to but distinct from both naval aviator and naval flight officer wings.[393] Consequently, through the development and use of different insignia, the Navy has created three distinct groups within naval aviation.

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[387] For information of the aviation brown leather jacket see section 6803 3.b.(2): Navy Personnel Command, "6801-6806 Organizational Clothing," MyNavy HR, accessed April 16, 2022, https://www.mynavyhr.navy.mil/References/US-Navy-Uniforms/Uniform-Regulations/Chapter-6/6801/.

[388] For an example of an aircrewman protesting the surface warfare jacket see: "Get Your Own Jacket," U.S. Naval Institute, April 1, 2020, https://www.usni.org/magazines/proceedings/2020/april/get-your-own-jacket; For the instruction authorizing the surface warfare jacket see: Chief of Naval Operations, *Management and Control of the Surface Warfare Officer Leather Jacket*, OPNAV Instruction 10126.5 (Washington, DC: Department of the Navy, 2019).

[389] For a description and images of all naval breast insignia see: Navy Personnel Command, "5201 - Breast Insignia," MyNavy HR, accessed May 2, 2022, https://www.mynavyhr.navy.mil/References/US-Navy-Uniforms/Uniform-Regulations/Chapter-5/5201-Breast-Insignia/#5201.3; For information on aerial vehicle operator insignia see: Navy Personnel Command, "Applicant Information."

[390] Grossnick, *United States Naval Aviation, 1910-1995*, 308, 341, 359.

[391] Grossnick, 655–56.

[392] Grossnick, 665–66.

[393] Currently an image of aerial vehicle operator wings is unavailable. Navy Personnel Command, "Applicant Information."

Figure 22. Naval Aviator Designation Wings[394]

Figure 23. Naval Flight Officer Designation Wings[395]

C. SYMBOLISM OF THE PILOT ROLE

According to Schultz, pilot identity stems from World War I where pilots emerged "as the icon of flight, confident master of throttle, stick, and rudder—a heroic figure in a leather jacket and white scarf."[396] Though this portrayal has become inaccurate both literally, since pilots no longer wear white scarves, and behaviorally since pilots are assisted by computers, remnants of this heroic, carefree image have survived.[397] In identity

[394] Source: Wikipedia, s.v, "Applicant Information," last modified March 29, 2022, https://en.wikipedia.org/w/index.php?title=Badges_of_the_United_States_Navy&oldid=1079965055.

[395] Source: Wikipedia, "Applicant Information."

[396] Schultz, *The Problem with Pilots: How Physicians, Engineers, and Airpower Enthusiasts Redefined Flight*, vii.

[397] John Lehman, "Is Naval Aviation Culture Dead?," *Proceedings*, September 1, 2011, https://www.usni.org/magazines/proceedings/2011/september/naval-aviation-culture-dead.

theory, each role is associated with specific signs and symbols, and through these signs and symbols, people can confirm their identity.[398] Similar to how ships and sails symbolized freedom and beauty to the line officers, aircraft, and related symbols like wings of gold, represent freedom and beauty to pilots. John Magee captured the feeling in his poem "High Flight" by writing:

> Oh, I have slipped the surly bonds of earth…I've climbed and joined the tumbling mirth of sun-split clouds—and done a thousand things you have not dreamed of…I've topped the wind-swept heights with easy grace, where never lark, or even eagle, flew.[399]

This poem glamorizes what the pilot accomplishes with an aircraft by claiming that the pilot can go places that not even birds can go, and it illustrates the emotional component of human flight. This emotional component comprises accidental properties of the aircraft unrelated to the essential properties that dictate its performance.[400] The aircraft represents freedom from earth. Dunn, in a 1986 article on naval aviators, wrote "aviators—especially tailhook aviators—are a cocky breed. Even they will confess that much" because they "see themselves as a small sect of competitive and spirited perfectionists."[401] Consequently, the pilot identity revolves around individual abilities to successfully operate and utilize aircraft.

Pilots are associated with boldness and daring because they risk their lives to operate an aircraft. Dunn wrote that aircraft became a romantic weapon because "the human being as combatant animal was raised to the level of the angels" and "combat became a matter of individuals locked in single mortal strife."[402] Phrases such as "flying by the seat of your pants" date back to the early days of flight when few aircraft controls

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[398] Burke and Stets, *Identity Theory*, 108–9.

[399] Michael Robert Patterson, "High Flight," Arlington National Cemetary, last modified May 18, 2009, http://www.arlingtoncemetery.net/highflig.htm.

[400] Teresa Robertson Ishii and Philip Atkins, in *The Stanford Encyclopedia of Philosophy*, ed. Edward N. Zalta, s.v. "Essential vs. Accidental Properties," accessed March 2, 2022, https://plato.stanford.edu/archives/win2020/entries/essential-accidental/.

[401] Michael L. Dunn, "The Naval Aviator," *Proceedings*, October 1, 1986, 100–101, https://www.usni.org/magazines/proceedings/1986/october/naval-aviator.

[402] Dunn, 101.

were automated highlight the instinctual nature required to survive and effectively fly an aircraft.[403] This phrase makes the pilot an important actor in the human-aircraft relationship because it implies that the pilot has unique skills that affect flight performance. The pilot determines survival, not the machine, depending on his or her skill. Moreover, it emphasizes the visceral connection between aircraft and pilot. One cannot fly by the seat of their pants if they are not in the seat within the aircraft hearing, smelling, seeing, and feeling the aircraft. This sentiment was repeated by former Secretary of the Navy John Lehman, when he declared that "aviators have been the principal source of offensive thinking" because of "those attributes of naval aviators—willingness to take intelligent calculated risk, self-confidence, even a certain swagger."[404]

Popular culture reinforces the pilot identity by portraying pilots as heroic and daring figures capable of surviving any challenge in the air through their superior capabilities. Personality characteristics attributed to pilots, like boldness, competitiveness, and a carefree nature are perpetuated in popular culture. For instance, in *The Right Stuff* (see Figure 24), a reality-based film, Chuck Yeager, an Air Force test pilot who broke the sound barrier, refused to associate with the astronaut program saying to the recruiters:

> you boys don't need no honest to God pilots, you know what you ought to do is to get a little old lab rabbit to climb up in your damn capsule…anything that goes up in the thing is going to be Spam in a can.[405]

This statement reinforces the perception that pilots accept personal risk by flying, have autonomy over decision-making, and must be in complete control of the aircraft. Moreover,

[403] Harry Oliver, *Flying by the Seat of Your Pants: Surprising Origins of Everyday Expressions* (New York, NY: Perigee Book, 2011), 36.

[404] Lehman, "Is Naval Aviation Culture Dead?"

[405] *The Right Stuff,* directed by Philip Kaufman, (1984; Burbank, CA: Warner Bros, 1984), https://www.amazon.com; The statements Yeager's character made in the film reflect Yeager's actual sentiments about the astronaut program. In his autobiography he wrote that astronauts were "little more than Spam in a can, throwing the right switches on instructions from the ground" and that they should not "get a dime for being selected for the space program, especially when the risks involved weren't half as great as some of the research flying" done by test pilots in recent years. See: Chuck Yeager, *Yeager: An Autobiography* (Toronto, Ontario: Bantam Books, 1985), 341.

without those capabilities, pilots become lab rats or rabbits. The Navy and Hollywood continue to market the traditional pilot characteristics in the new *Top Gun: Maverick* (see Figure 25) by highlighting Maverick's relevance, unique skillset, and invincibility.[406] Consequently, popular culture along with Navy marketing have perpetuated the traditional pilot identity.

Figure 24. Movie Poster for *The Right Stuff*[407]

[406] *Top Gun: Maverick | NEW Official Trailer (2022 Movie) - Tom Cruise*, March 29, 2022, Paramount Pictures, video, 2:30, https://www.youtube.com/watch?v=giXco2jaZ_4.

[407] Source: "The Right Stuff," Past Posters, accessed May 2, 2022, https://www.pastposters.com/details.php?prodId=17085.

Figure 25. Movie Poster for *Top Gun: Maverick*[408]

D. GROUP COLLECTIVE ACTION: REINFORCEMENT OF NAVAL AVIATOR CENTRALITY

When seen through the lens of social identity theory, naval aviation's hierarchical nature fosters competition and threats to naval aviator dominance could result in group collective action against that threat.[409] According to Turner and Tajfel, the "mere awareness of the presence of an out-group is sufficient to provoke intergroup competitive or discriminatory responses" from the in-group.[410] Such as response would not be unprecedented because pilots have fought against uncrewed aircraft already. For instance, in the early 2000s, the primary advocate of the Triton, Captain Alan Easterling, fought against a dichotomy within naval aviation:

[408] Source: "Top Gun: Maverick," IMDB, accessed May 10, 2022, https://www.imdb.com/title/tt1745960/?ref_=tt_mv_close.

[409] Hatch and Schultz, *Organizational Identity*, 56.

[410] Hatch and Schultz, 56.

> UAVs would likely never become a regular part of Navy inventory if they didn't enter as an adjunct, a mission augmentation or enabling subordinate partner to the crewed aircraft; budget for and acquisition of UAVs could simply not be justified in isolation with no connection to a mission area for which manned aircraft was already the preeminent platform. Yet the prevailing warfighter culture militated against any introduction of UAVs that were viewed as threats to funding for manned aircraft and their crews.[411]

Basically, uncrewed aircraft had to be subordinate to crewed aircraft, but contribute enough to the Navy's mission to be considered a possibility by naval leaders. Easterling implemented a strong socialization campaign to combat cultural resistance within the Navy to the Triton and the challenges it brought to the traditional pilot identity.[412] To successfully get funding and support for the Triton, Easterling had to advertise the Triton as a highly complementary, subordinate to the P-3 Orion crewed aircraft that it was designed to work with.[413]

The aircraft carrier strike group model the Navy operates reinforces the centrality of the pilot within naval aviation, and the Navy more broadly. Though the first Triton squadron was established in 2016, naval aviation is still biased toward pilots and crewed aircraft.[414] Former naval aviators Ernest Snowden and Robert Wood argue that the "role of the naval aviator in the Navy's identity remains paramount" today because the naval aviation as the visible power projection arm of the service still revolves around pilots.[415] Echoing other Navy planning and strategy documents, the *Navy Aviation Vision 2030–2035*, describes the carrier strike group (see Figure 26) as "the weapon that defines Navy

[411] Snowden and Wood Jr., *Maritime Unmanned: From Global Hawk to Triton,* 103.

[412] Snowden and Wood Jr., 104, 112.

[413] Snowden and Wood Jr., 13.

[414] For the establishment of VUP-19 see: Snowden and Wood Jr., 11.

[415] Snowden and Wood Jr., 1–2.

power projection and will remain so for decades to come."[416] The carrier strike group is an ecosystem built around moving and supporting the air wing and the associated pilots. Because the current carrier air wing model consists of all crewed aircraft, the pilots are at the center of the carrier universe.[417] And because technology and its implementation are often designed to accommodate the human element, aircraft designs and the carrier ecosystem could change when pilots are removed from the cockpit.[418]

Figure 26. Carrier Strike Group Five arriving in Republic of Korea in 2016[419]

[416] NAVAIR, *Navy Aviation Vision 2030-2035* (San Diego, CA: NAVAIR, 2021), 8, https://cle.nps.edu/access/content/attachment/efbadfbf-d9ba-43a0-b9c0-9fc0bea50a21/Announcements/c17edc67-e4f1-4a9f-92d2-b3a5696fb5df/2021%20Dist%20A%20NAE%20Vision%202030-2035%20Oct%202021.pdf; For another example see: M.M. Gilday, *CNO NAVPLAN* (Washington, DC: Department of the Navy, 2021), 12, https://www.navy.mil/Press-Office/Press-Releases/display-pressreleases/Article/2467465/cno-releases-navigation-plan-2021/.

[417] NAVAIR, *Navy Aviation Vision 2030-2035*, 10–11.

[418] Schultz, *The Problem with Pilots: How Physicians, Engineers, and Airpower Enthusiasts Redefined Flight*, 1.

[419] Source: Sara B. Sexton, "Carrier Strike Group Five Arrives in Busan," Commander, U.S. 7th Fleet, last modified October 16, 2016, http://www.c7f.navy.mil/Media/News/Display/Article/975106/carrier-strike-group-five-arrives-in-busan.

Furthermore, the language the Navy currently uses to describe the different categories of pilots and aircraft reinforces the centrality of the human pilot. Recent Navy planning documents use the terms "manned" and "unmanned" to categorize aircraft based on whether a human is physically in the cockpit.[420] Just like calling naval personnel "sailors" forms an identity based on sail power, differentiating between aircraft based on human presences reinforces the centrality of the human and the traditional pilot identity.[421] By focusing on the sole factor of human presence, these terms illustrate social identity theory's conclusion that language exaggerates the difference between what does and does not go into a category while minimizing the differences between items or people put in the same category.[422] In this case, aircraft are separated solely based on whether a pilot is in the cockpit while it is airborne, which understates the other differences between aircraft. Similarly, pilots are distinguished based on whether they sit in an aircraft instead of other potential differences. This focus on human centrality ignores how the current transition from crewed to uncrewed aircraft changes the pilot role. Consequently, language, as well as the naval force structure, encourage intergroup conflict between pilots of crewed versus uncrewed aircraft.

E. TRADITIONAL PILOT BEHAVIORS CHALLENGED

Under social identity theory, people compare their role-related actions with the behaviors associated with that role to confirm their identity.[423] Because the pilot identity is rooted in the cockpit, the transition to uncrewed aircraft changes behaviors associated with being a pilot such as physically sitting in an aircraft and operating it. When their behavior and expectations do not match, they may become dissatisfied, withdraw from the role, or try to reassert their identity's legitimacy.[424] Uncrewed aircraft pilots are often

[420] For examples see: NAVAIR, *Navy Aviation Vision 2030-2035*, 2, 6, 10, 12; Department of the Navy, *Department of the Navy Strategic Roadmap for Unmanned Systems* (Washington, DC: Department of the Navy, 2018), 2,3, https://www.secnav.navy.mil/rda/Documents/Forms/DispForm.aspx?ID=47; Department of the Navy, *Department of the Navy Unmanned Campaign Framework*, 1-3,6.

[421] See Chapter III Section C.1 for more information on the term "sailors" and line officers.

[422] Billig, *Social Psychology and Intergroup* Relations, 338.

[423] Stets and Burke, "Identity Theory and Social Identity Theory," 233.

[424] Burke and Stets, *Identity Theory*, 116, 159.

located hundreds of miles or several countries away from the aircraft they control. For instance, the Unmanned Patrol Squadron's first Triton was flown in California by pilots in Florida.[425] Based on Snowden and Wood's account, instead of being inside a cockpit, physically sensing the environment, the Triton pilots were "buried deep inside a brick-and-mortar building …bathed in blue light, monitoring sensor images and issuing digital commands from their keyboards."[426] Similarly, Stingray pilots will control aircraft from a command center on the carrier.[427] Gone are the joy, freedom, and associated power conveyed in the lines of Magee's "High Flight." As the Triton example illustrates, uncrewed aircraft pilots are very much attached to the earth still. While their aircraft climbs sunwards, they stare at screens inside a building or a ship.

The distancing also challenges the risk-taking behavior associated with being a pilot. By stepping into an aircraft, pilots accept personal risk because they could crash or be shot down. But with an uncrewed aircraft, the plane may go down and yet the pilot still goes home for dinner. To exemplify this phenomenon, one former uncrewed aircraft pilot described operating an aircraft overseas while being in the United States as surreal because he was "fighting two wars simultaneously 1,500 miles apart and balancing them with a wife and kids…paying the bills, and calling the plumber because the toilet was stopped up."[428] As the distance from the cockpit increases, the physical risk of flying decreases, while the separation between work and home life blurs.

According to naval planning documents, the Navy is adopting uncrewed aircraft partially to decrease the risk to human life.[429] The removal of physical risk strips away the status and glamour pilots gain by stepping into a cockpit and relying on their expertise and

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[425] Snowden and Wood Jr., *Maritime Unmanned: From Global Hawk to Triton,* 12–13.

[426] Snowden and Wood Jr., 12; For more detailed information on the environment Triton pilots work in see: "Flight Crew: Triton AirCrew," August 18, 2016, NAVAIRSYSCOM, video, 5:42, https://www.youtube.com/watch?v=RqaSxanJJ80.

[427] John R. Hoehn and Paul K. Kerr, *Unmanned Aircraft Systems; Current and Potential Programs,* CRS Report No. R47067 (Washington, DC: Congressional Research Service, 2022), 8, https://crsreports.congress.gov/product/pdf/R/R47067.

[428] Matt J. Martin and Charles W. Sasser, *Predator: The Remote-Control Air War Over Iraq and Afghanistan: A Pilot's Story* (Minneapolis, MN: Zenith Press, 2010), 85.

[429] Department of the Navy, *Department of the Navy Unmanned Campaign Framework*, 10.

knowledge to return.[430] Being disconnected from the cockpit complicates the psychology of translating their skills over to uncrewed aircraft.

Furthermore, as the pilot's role evolves toward being a battlefield manager, the pilot must put more trust into the machine's ability to complete what used to be human tasks. The traditional pilot identity is antithetical to trusting the machine completely because it is based on assuming responsibility for the aircraft and surviving based on a special skillset not on letting the machine do much of the thinking and all the work.[431] According to a 2017 report on the development of autonomy in weapons systems, military personnel often distrust autonomous systems because they do not believe that "advanced autonomy can perform as intended in all situations" and the most recent systems lack field experience.[432] Pilots of crewed aircraft trust themselves to successfully complete missions and return with the aircraft.[433] Now, uncrewed aircraft reverse the model somewhat, by taking some of the mission responsibility from the pilots. Consequently, the power balance is changing not only between types of pilots but between pilots and machines, which could encourage resistance from crewed pilots.[434]

F. BRIDGES' TRANSITION MODEL APPLICATION

Today, naval aviation is at risk for pilot resistance to uncrewed aircraft and aerial vehicle operators because the pilot identity is attached to crewed aircraft. While the Navy can swap people and technology relatively easily, it is more difficult to swap the psychological factors. Like line officers in the 1800s, pilots may inhibit the implementation of the new technology because it threatens the meaning and identity they have in the world.[435] By being removed from the cockpit completely or relegated to battlefield

[430] Schultz, *The Problem with Pilots: How Physicians, Engineers, and Airpower Enthusiasts Redefined Flight*, 159–61.

[431] Navy Recruiting Command, "Fighter Pilot"; Schultz, *The Problem with Pilots: How Physicians, Engineers, and Airpower Enthusiasts Redefined Flight*, vii.

[432] Boulanin and Verbruggem, *Mapping the Development of Autonomy in Weapon Systems*, 71.

[433] Schultz, *The Problem with Pilots: How Physicians, Engineers, and Airpower Enthusiasts Redefined Flight*, 159–60.

[434] Hatch and Schultz, *Organizational Identity*, 56.

[435] Bridges, *Managing Transitions*, x.

management instead of direct control over one aircraft, pilots lose the primary pieces of their identity. Some pilots may resist the removal or modification of that task as aerial vehicle operators take up similar tasks on the ground.

Naval aviation is primarily in the letting go, or first, phase of Bridges' transition model, where resistance is most likely to occur because people resist letting go of the old identity.[436] Letting go incurs a psychological cost because it manifests as feelings of loss, anger, anxiety, confusion, and uncertainty.[437] To prevent such feelings and protect the old identity, pilots, individually or in groups, might react by slowing the implementation of uncrewed aircraft.[438] As the Triton example shows, it is tricky to introduce new technology into naval aviation without upsetting the identity status quo. Just like the line officers who scrambled to retrieve pieces of their identity by emphasizing their dominance over engineers as well as the dominance of sail over steam power, pilots could try to reemphasize their dominant position in the naval aviation hierarchy by slowing down the adoption of uncrewed platforms and technological advances intended to enable naval forces to win wars.

G. ROGERS' MODEL APPLICATIONS

Rogers' organizational transition model provides insight into which pilots might resist uncrewed aircraft, when in the transition resistance is most likely, and how the new technology could affect adoption rates. Out of the five adopter categories he identifies, late adopters and laggards are the last to adopt new technology, potentially slowing down the transition for the entire organization.[439] According to Rogers, late adopters approach innovation "with a skeptical and cautious air" and require peer pressure to adopt the technology while laggards are reluctant to part from the past and must be "certain that a

[436] Rogers, *Diffusion of Innovations*, 4.

[437] Bridges, *Managing Transitions*, 29–30.

[438] Bridges, 16.

[439] Also see Chapter I Section D for a list and Chapter IV Section B for a graph of all adopter categories. Rogers, *Diffusion of Innovations*, 282–85.

new idea will not fail before they can adopt."[440] Like line officers of the 1800s, only a small segment of pilots has to resist or reject the new technology to slow down implementation, reducing the Navy's effectiveness.

Naval aviation is currently in the two steps Rogers identifies as most likely to inspire resistance and rejection: redefining and clarifying. The new Stingray program is in the redefinition stage because naval aviation is still figuring out how to fit the MQ-25 Stingray within its existing organizational structure, the first class of aerial vehicle operators graduated in January 2022, and the aircraft is not yet operational.[441] According to Rogers both the organization and the technology need to change in this process but the organization often underestimates the changes required and misses the small "window of opportunity" to make the modifications.[442] The Triton and Fire Scout programs, more established than the Stingray, are in the clarifying stage of Rogers model where the relationship between the aircraft and the Navy is more defined and the aircraft start to become a routine part of naval operations.[443] Therefore, the Navy still has time to manage the identity transition proactively and to avoid repeating the long and conflict-ridden transition from sail-to-steam power.

Finally, during this transition naval aviation should be aware of and use the five technology characteristics Rogers identifies to increase adoption rates: complexity, compatibility, trialability, observability, and relative advantage. In the sail-to-steam case study, some line officers resisted steam power because it was complex in requiring completely new knowledge and incompatible with their values and experience.[444] In the current transition, uncrewed aircraft require different pilot skillsets because satellites and

[440] Rogers, 284.

[441] Darwin Lam, "First Warrant Officer Aerial Vehicle Operators Graduate from Officer Candidate School," *Defense Visual Information Distrbution Service*, January 28, 2022, https://www.dvidshub.net/news/413585/first-warrant-officer-aerial-vehicle-operators-graduate-officer-candidate-school; Shelbourne, "Navy Wraps Up MQ-25A Deck Handling Tests on Carrier USS George H.W. Bush."

[442] Rogers, *Diffusion of Innovations*, 424–25.

[443] Rogers, 421.

[444] See Chapter IV Section B for the characteristics of sail versus steam power discussion.

computers moderate pilot commands, and pilots can be inhibited by techniques learned for crewed aircraft.[445] Consequently, uncrewed aircraft could be perceived as too complex and incompatible with current pilot skillsets. Compatibility and complexity can be mitigated or worsened by the other technology characteristics: relative advantage, trialability, and observability.[446] To increase the speed of adoption of uncrewed aircraft, pilots' perceptions need to change. In order to change pilot's views, naval aviation leaders should better promote these capabilities within the community, perhaps with demonstration flights, and pilots trained on other platforms should be able to try them out.

H. CULTURE AND SCHOOLING

Unlike the sail-to-steam case study, schooling is not a likely contributing factor to potential resistance in the crewed-to-uncrewed aircraft transition because all pilots share certain phases of training regardless of platform.[447] Pilots and aerial vehicle operators both complete initial flight training, and then go on to specialize in their respective aircraft type: crewed or uncrewed.[448] Also, pilots of all types learn to fly through similar methods, for example, simulators, which increases understanding of each other's jobs.[449] Therefore, naval aviators are familiar with both aerial vehicle operators and the skills the aerial vehicle operators learn. In the sail-to-steam study, the Naval Academy was slow to establish a steam engineering program and allow midshipmen to graduate as engineers, which reinforced the separation between line officers and engineers.[450] In the current transition,

[445] Schultz, *The Problem with Pilots: How Physicians, Engineers, and Airpower Enthusiasts Redefined Flight*, 160–61.

[446] Rogers, *Diffusion of Innovations*, 265–66.

[447] Navy Personnel Command, "Applicant Information"; Lam, "First Warrant Officer Aerial Vehicle Operators Graduate from Officer Candidate School."

[448] Navy Personnel Command, "Applicant Information"; Chief of Naval Air Training, *Chief of Naval Air Training: Naval Introductory Flight Evaluation (NIFE)*, CNATRAINST 1542.178A (Corpus Christi, TX: Naval Air Training Command, 2020), https://www.cnatra.navy.mil/local/docs/mcg/1542.178.pdf.

[449] "Navy Aviators Learn to 'Fly' the MQ-25 Unmanned Aerial Refueler," NAVAIR, October 29, 2020, https://www.navair.navy.mil/news/Navy-aviators-learn-fly-MQ-25-unmanned-aerial-refueler/Thu-10292020-1541; NAVAIR, *Navy Aviation Vision 2030-2035*, 22.

[450] See Chapter IV Section C for more information on the Naval Academy's steam engineering programs in the mid-1800s.

though Naval Academy graduates cannot specialize in uncrewed aircraft, pilots are not insulated from aerial vehicle operators.

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VI. RECOMMENDATIONS, LIMITATIONS, AND FUTURE RESEARCH

Identity affects how people think and react because it creates a stable foundation for interacting with others and establishing their mission and purpose. Technology, identity, and social system are tightly connected. When the technology at the root of an identity changes or is replaced, the change creates instability, identity confusion, and emotional reactions—all attempts to reestablish the identity and secure the foundation. While technological change is a natural process many organizations go through, this thesis highlights a pattern within tech transitions in the Navy. Historically, the Navy has ignored the impact technological changes have on identity. By overlooking identity issues, the Navy has encouraged and prolonged individual and group identity-based resistance, and internal conflict has degraded force cohesion. Moving forward, the Navy must encourage unity by avoiding divisive practices and emphasizing the compatibility of new technology with the ethos and mission of the foundational identity.

A. RECOMMENDATIONS

Naval aviation can overcome the personnel challenges involved in adapting a hybrid aircraft environment by changing aircraft category labels, highlighting the compatibility of uncrewed aircraft with the pilot identity, and creating a common identity and viable career paths for all pilots. The following recommendations, if implemented before MQ-8C Fire Scout and MQ-25 Stingray aircraft are fully established within the Navy, could alleviate pilot resistance to the increased implementation of uncrewed aircraft and aerial vehicle operators by encouraging unity instead of division.[451] The needed language and cultural changes will be more challenging to make once the currently planned squadrons commission, the aircraft deploy, and personnel fill the squadrons.

Because cultural transformation take time, it is imperative change begins now, to allow for maximum time to work through obstacles. By starting the changes now, the Navy

[451] The MQ-8C is planned to be operational in 2024 followed by the MQ-25 in 2025.

can fully leverage both humans and uncrewed aircraft to maintain its warfighting advantage over adversaries. As uncrewed aircraft continue to be developed, the Navy must get ahead and stay in front of the associated identity and cultural impacts to stop running into the same set of problems every time new technology is introduced. The goal of these recommendations is to broaden the discussion on the psychological impact the transition has on crewed pilots. These recommendations are examples of potential solutions and the questions the Navy must answer moving forward.

1. Change the Language and Highlight Compatibility

First, Navy and naval aviation leaders should reevaluate whether the terms "pilot," "naval aviator," and "aerial vehicle operator" (as well as the implicit and explicit distinctions among them) should all be retained. Language carries social meaning because it denotes who or what belongs in a category.[452] The linguistic divide naturally creates a psychological divide between crewed and uncrewed aircraft pilots and invites competition for dominance.[453] By differentiating between pilots based on the crewed-uncrewed aircraft categorization, the Navy is perpetuating the perception that the two groups are different.

Possible options fall into three general categories: broaden the naval aviator designator to include pilots of all types, create a singular new name for all pilots, or keep "pilot" and "naval aviator" but add specific descriptors to denote aircraft type. In the first option, the Navy would retain the formal naval aviator designator, but expand its use to include pilots of all types, including the new aerial vehicle operators. "Naval aviator" would replace the "aerial vehicle operator" designation.[454] The second option, as the most radical change, requires establishment of a completely new name for all pilots that encapsulates a piece of the old identity and fits it with the current reality of pilot tasks. The third option blends the current and new pilot labels equally. Every pilot would be called

[452] Billig, *Social Psychology and Intergroup Relations*, 325–26.

[453] Billig, 308–12.

[454] Historically, before the term naval aviator became the formal designator for pilots within the naval service, naval aviation used it designate someone who completed the initial part of Navy flight training but had not completed advanced training to be called a navy air pilot. Under this criteria, aerial vehicle operators are naval aviators, so including them under the naval aviator umbrella is not a leap from historical precedent. Grossnick, *United States Naval Aviation, 1910-1995*, 402.

either "pilot" or "naval aviator" and a descriptive denoting the aircraft type or mission set they perform. For example, MQ-8C pilots could be called helicopter pilots along with MH-60 pilots, especially since some people have flown both platforms within the same squadron.[455] The Navy should avoid using distanced terms like "manager" and "operator" because they are too far from the traditional pilot identity.[456]

Similarly, to promote unity among all pilots, Navy and naval aviation leadership should create new labels for aircraft categories that are not based on human presence. By categorizing aircraft as "manned" or "unmanned" the Navy highlights and prioritizes the pilot's presence in the cockpit and perpetuates an automatic division that encourages intergroup competition. In this regard, this thesis took one step forward by using "crewed" and "uncrewed" to avoid gendered language. However, the Navy must go a step further to adopt terms that do not revolve around human presence at all. More relevant differences could be emphasized, such as mission set, physical attributes, and performance characteristics. For instance, the MQ-25 could be classified as a tanker or aerial refueling aircraft because of its primary refueling mission. Integrating uncrewed aircraft within this framework follows Rogers' recommendation to mold the innovation and organization to fit each other.[457]

To increase pilot adoption rates, the new terms should emphasize the compatibility of uncrewed aircraft with the values, beliefs, and experiences connected to crewed aircraft and the crewed pilot identity.[458] As Rogers wrote, "words are the thought units that color perceptions."[459] Words form people's first impressions. Naval leaders must understand that the immediate impression pilots and other users of the new technology have from the terms "manned" and "unmanned" is that the main difference between the aircraft is where

[455] For pilots operating both MH-60 and MQ-8 aircraft see: Eckstein, "Navy Fielding MQ-8C Fire Scout to Operational Squadrons Ahead of Deployment Next Year."

[456] William DuBois, "The Origin of the Word 'Pilot' for Operator of an Aircraft?," *Canadian99s* (blog), December 28, 2020, http://canadian99s.com/the-origin-of-the-word-pilot-for-operator-of-an-aircraft/.

[457] Rogers, *Diffusion of Innovations*, 424.

[458] Rogers, 249.

[459] Rogers, 251.

the human operator is located. Uncrewed aircraft must be advertised not as a challenge or a separate division, but as a means to expand naval capabilities to maintain the warfighting advantage. To create unity between all pilots, uncrewed aircraft must be described and perceived as satisfying pilot needs and fitting within the existing pilot ethos.[460] Because the pilot identity is based on being one of the chosen few who are privileged and talented enough to control aircraft, the Navy has to introduce uncrewed pilots as worthy of being in that same category. Once new terms are established, "manned" and "unmanned" should be removed from official use. For instance, Unmanned Patrol Squadron Nineteen's name would have to change to Patrol Squadron Nineteen, Maritime Patrol Squadron Nineteen, or another name that removes the human emphasis.[461] Again, change will be easier now when there is only one squadron name change.

2. Build a Common Identity

First, based on Bridges' recommendations, Navy and naval aviation leaders must maintain constant and clear communication with all personnel within the organization about the transition, what is and is not changing for crewed pilots, and what the change means for those grandfathered into the system.[462] To achieve this goal, the changes should be discussed at all levels within naval aviation from ready rooms within squadrons to top naval leadership in the Pentagon. Within these discussions, the compatibility of uncrewed aircraft and their pilots with crewed pilots and aircraft should be highlighted to minimize resistance from crewed pilots and begin forming a common identity inclusive of all pilots and aircraft. As seen in Chapter II, the two aircraft types developed together, yet crewed aircraft are often in the forefront of naval aviation's recollection and narrative.

Moving forward, the Navy must be intentional and comprehensive in managing the mystique of the naval pilot and telling the naval aviation narrative both inside and outside of naval aviation. Molding the mystique to reflect the composition of naval aviation and

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[460] Rogers, 246.

[461] Michael D. Roberts, *Dictionary of American Naval Aviation Squadrons: Volume 2*, vol. 2 (Washington, DC: Naval Historical Center, 2000), 107–12.

[462] Bridges, *Managing Transitions*, 25, 32–33.

blending the crewed and uncrewed aircraft histories together will increase force cohesion. The narrative should be respectful of both crewed and uncrewed pilot and aircraft accomplishments.[463] It must be implemented everywhere naval aviation's story is told, not just naval aviation history books.[464] This representational completeness includes squadrons, recruitment, naval flight training, the National Naval Aviation Museum, media productions, future official publications from naval leaders that include historical elements, and any other location or publication that includes naval aviation history or mythology.

In this expansion of who and what is included in the naval aviation narrative, crewed pilots must be allowed to keep a piece of the old identity with them. According to Bridges, "endings occur more easily if people can take a bit of the past with them" because it smooths the transition from old to new and enforces the idea that the old is not being thrown out but put aside.[465] If the Navy retains the terms "pilot" and "naval aviator and extends them to uncrewed aircraft pilots, new questions arise about the symbols linked to those terms. Do all pilots earn brown jackets and naval aviator wings? One potential answer is to issue all pilots brown jackets and keep the different designation wings. The jackets, along with brown shoes, separate aviation officers as a whole from submarine and surface warfare officers. The designation wings represent sub-divisions within the aviation community. New questions arise if the Navy creates a completely new term for pilots, naval aviators, and aerial vehicle operators. Changing the name creates an opportunity to develop new symbols to encapsulate the quickly evolving community. Regardless of the exact decisions made, crewed pilots should be allowed to retain some piece of the old identity to reassure them that it not being erased but set aside.[466]

3. Structural Change

Finally, the Navy must reevaluate the decision to make MQ-25 Stingray pilots warrant officers. Based on the research, separating pilots into two officer types is a mistake.

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[463] Bridges, 34–35.

[464] Grossnick, *United States Naval Aviation,* 1910-1995.

[465] Bridges, *Managing Transitions*, 35–36.

[466] Bridges, 35.

In the sail-to-steam case study, line officers perceived engineers, as staff officers, as a threat to their authority.[467] The line officer resistance to steam power and engineers also stemmed from confusion over the different rank structures used for each group and the larger staff-versus line-officer controversy that developed throughout the mid- to late 1800s.[468] More recently, in the 1960s, tensions flared between naval aviators and naval flight officers because federal code restricted naval flight officers from assuming aviation commands despite being designated unrestricted line officers.[469] Pilots be placed in one rank structure and officer category because dividing them into different rank structures and career paths increases the potential for conflict and resistance.

B. LIMITATIONS

This thesis intentionally focused on the Navy to establish a pattern of behavior in technological transitions within the naval service. Because this thesis focused only on the Navy's transition to uncrewed aircraft, it ignored potential lessons learned from the Air Force's transition to uncrewed aircraft and the creation of the Space Force. For instance, the Air Force in developing its own uncrewed aircraft capabilities, experienced pilot resistance to the changes.[470]

By analyzing one historical case study, this thesis sacrificed a larger sample size for depth of analysis. It could be argued that the conclusions would be stronger if based on more than the sail-to-steam case study, which is also from two centuries ago. However, exploring the one case study allowed time and resources for in-depth analysis, resulting in stronger connections between the case study and the current transition.

The identity focus in the sail-to-steam case study is an imperfect comparison to the crewed-to-uncrewed aircraft transition because, while identity-based resistance contributed

[467] Refer to Chapter III Section B.1.

[468] Refer to Chapter III Section B.1.

[469] Loftus, "Career Development for the Naval Flight Officer."

[470] Caitlin Lee, "The Role of Culture in Military Innovation Studies: Lessons Learned from the US Air Force's Adoption of the Predator Drone, 1993-1997," *Journal of Strategic Studies*, September 26, 2019, 1–35, https://doi.org/10.1080/01402390.2019.1668272; Houston R. Cantwell, "Operators of Air Force Unmanned Aircraft Systems: Breaking Paradigms," *Airpower Journal* 23, no. 2 (July 1, 2009): 67–77.

to delaying steam power, it was not the only factor. National economic issues, federal and military budget constraints, problems in the development of steam engines, and lack of international coaling stations also inhibited the implementation of steam engines on naval vessels. Also, the sail-to-steam transition involved a complete and total switch from sail power to steam power on all naval vessels. In the current transition, the Navy is not replacing all crewed aircraft with uncrewed aircraft.

Lastly, this thesis relied on open source publicly released documents to maintain unclassified, unlimited distribution. More detailed information is available from limited distribution or classified sources about how uncrewed aircraft are being and will be implemented.[471]

C. FUTURE RESEARCH

There is room to expand the scope of this research by including other case studies or field research. The battleship-to-carrier transition in the early 1900s is another potentially useful case study to learn from. By adding case studies, discussion could be broadened beyond the impacts on pilot identity to the impacts on naval aviation doctrine and strategy, which is part of naval aviation culture and identity. Field research, including surveys of actual pilots, of both crewed and uncrewed, would establish a baseline on the actual resistance to uncrewed pilots and aircraft within the Navy. That data could be used to tailor a detailed plan to minimize resistance most effectively.

[471] Department of the Navy, *Department of the Navy Unmanned Campaign Framework*, 1, 6.

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