

Charging Ahead: How the Army Can Learn from the Past to Prepare for Electric Vehicles in the Future

A Monograph

by

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2020

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REPORT DOCUMENTATION PAGE

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1. REPORT DATE (DD-MM-YYYY) 05/01/2020	2. REPORT TYPE AMSP Monograph	3. DATES COVERED (From - To) August 2019 – May 2020
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4. TITLE AND SUBTITLE Charging Ahead: How the Army Can Learn from the Past to Prepare for Electric Vehicles in the Future	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S) MAJ Gregory Hom	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Advanced Military Studies Program 250 Gibbon Avenue Fort Leavenworth, KS 66027-2134	8. PERFORMING ORGANIZATION REPORT NUMBER
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9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Command and General Staff College 1 Reynolds Avenue Fort Leavenworth, KS 66027	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for Public Release; Distribution is Unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
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15. SUBJECT TERMS
Organizational Change, electric vehicles, military transitions, technology

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT U	18. NUMBER OF PAGES 53	19a. NAME OF RESPONSIBLE PERSON
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (Include area code)

Monograph Approval Page

Name of Candidate: MAJ Gregory J. Hom

Monograph Title: Charging Ahead: How the Army Can Learn from the Past to Prepare for Electric Vehicles in the Future

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Abstract

Charging Ahead: How the Army Can Learn from the Past To Prepare for Electric Vehicles in the Future by MAJ Gregory Hom, 54 pages.

The US Army is currently entering a time of uncertainty as there appears to be a return to great power competition, and a more realistic requirement to conduct large-scale ground operations. The tyranny of distance and the challenge of entering militarily contested areas could be mitigated by the adoption of electric vehicles, and new supporting electric technologies. This monograph uses the Army's transition from horses to motorized vehicles during the interwar period, and Tesla Motors production of the Model S during the 2000s as case studies to examine the implications of changing the ground movement paradigm. This monograph seeks to identify the challenges and effects of organizational change.

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Acknowledgements

Dr. Kidd and LTC Jacobs, thank you for your mentorship and patience. I would also like to thank my seminar for all their help and logical course corrections. To the people who matter most to me, I want to thank Jessica, Amelia, and Madeline for their inspiration, love, and support.

Introduction

After nearly four months of logistical preparation, on February 24, 1991, US ground forces attacked Iraqi military forces occupying Kuwait, commencing Operation Desert Storm. The combined might of the US military easily penetrated the Iraqi defenses and destroyed their resistance, forcing the Iraqi government to accept a cease-fire on the morning of February 28. While the American maneuvers were an astounding success, operational planners recognized the constraints of their victory. The US Army had nearly outrun their logistical support. Critical shortages, specifically in fuel, would have forced the US Army to cede the initiative, and take a lengthy operational pause had the Iraqis not quit the field.¹

In the nearly thirty years since the Gulf War, the depth of the battlefield has increased, intensifying the US Army's logistical burdens. The emergence of anti-access and area denial enclaves designed to counter operational reach has compounded this problem. Longer range missiles and weapons are aimed to deny or degrade the US' ability to stockpile supplies, and transition to the offense. Extended lines of supply, and the necessity to disperse forces for security, will quickly overtax current fuel distribution methods.² The US Army's Combined Arms Center recently recognized line-haul and tactical fuel distribution as a critical gap.³ In a contested environment, balancing the risk of resupplying forward elements while potentially exposing their positions becomes increasingly dangerous. If the US Army engaged in large-scale combat operations today, they face as challenging an operating environment as their predecessors did in 1991.⁴

¹ Jason Carrico, "Mitigating the Need for a Logistic Pause" (Masters Monograph, US Army Command and General Staff College, 2006), 17.

² Mike Lundy, "Large Scale Ground Combat Operations Study" (presented to the School of Advanced Military Studies, Ft. Leavenworth, KS, June 18, 2019).

³ Ibid.

⁴ US Department of Defense, Joint Publication (JP) 3-0: *Joint Operations* (Washington, DC:

In 2020 alone, the US Army is spending \$1.4 billion of its annual budget towards the development of improved energy systems and electrical storage capabilities for soldiers and vehicles.⁵ Coupled with the US Army's overt messaging, they demonstrated a clear intent to transition their fleet, specifically their armored vehicles, to one less dependent on fossil fuels.⁶ The Future Combat Vehicle subsidiary, Ground Vehicle Systems Center, has been hard at work integrating electric engines into armored vehicles. These developing engine technologies have nested well with the US Army's transition to focusing on large-scale combat operations. The adoption of electric motors to power ground maneuver to armored forces would be a significant transition.

Despite the billions spent annually on electric technology, there is little to no recent research available on the US Army's organizational requirements to implement a complete paradigm change in electric vehicles.⁷ The last time the US Army underwent a systemic change that affected the entire organization to this degree occurred between World War One and World War Two when the US Army transitioned from motorized vehicles from horses.⁸ There were significant lessons learned during this transition that may still be applied to today. Specifically, were their lessons learned that could address the US Army's challenges specific to this transition. Are there relevant recommendations to manage wholesale changes to the US Army's infrastructure?

Government Printing Office, January 17, 2017), IX.

⁵ Assistant Secretary of Defense for Sustainment, "Fiscal Year 2020 Operational Energy Budget Certification Report," Government Printing Office, Washington, DC: May 17, 2017, accessed March 22, 2020, <https://www.acq.osd.mil/eie/Downloads/OE/FY20%20Budget%20Certification%20Report.pdf>.

⁶ Joe Gould, "All-Electric Brigades? US Army Officials say it's Coming Sooner than You'd Think" *Defense News*, October 11, 2017, accessed September 10, 2019, <https://www.defensenews.com/digital-show-dailies/ausa/2017/10/11/all-electric-brigades-us-army-official-says-its-coming-sooner-than-you-d-think/>.

⁷ Assistant Secretary of Defense for Sustainment. "Fiscal Year 2020 Operational Energy"

⁸ John Daley, "Patton Versus the "Motor Maniacs": An Inter-war Defense of Horse Cavalry," *Armor Journal* 106, no 2, (March-April 1997): 4.

The logistic issues of the Gulf War still exist. The US Army cannot properly sustain itself at the operational and tactical level in large scale combat operations without external support or stockpiles.⁹ Fueling operations would become a critical vulnerability for any tank formation in the offense. Rapidly modernizing the force and transitioning to a more flexible electric fleet of vehicles is a possible way to reduce this logistic burden.

The purpose of this study is to bridge the gap in the available literature on the US Army's ability to transition with modern technology. The research seeks to draw conclusions from private industry and the US Army's previous organizational changes to better understand the challenges of the adoption of electric vehicles.

This study will use John Kotter's Eight Stage Change Model as a theoretical framework to examine the US Army's moves towards enduring organizational change.¹⁰ Kotter's change model was officially adopted as the US Army's standard model for leading organizational change in 2006.¹¹ He believed that enduring change needed to be implemented by an organization's leader who systematically acted to address a growing problem. Once the issue was identified, the leader would create a subordinate council to develop approaches to change, and then develop the new vision. These actions would manage change across the organization in a broad front to inspire and generate change, adding to its momentum. The leader would then use that momentum to anchor the successes within the organization.¹² This framework was especially useful to the military as the US Army's ingrained hierarchy enabled coalition creation and senior messaging. Kotter tailored his framework to address his observations on why organizational change failed.¹³

⁹ Lundy, "Large Scale Ground Combat Operations Study"

¹⁰ John P. Kotter, *Leading Change* (Boston, MA: Harvard Business School Press, 1996), 21.

¹¹ US Army, Field Manual 6-22, *Army Leadership: Competent, Confident and Agile*, (Washington DC: Government Printing Office, 12 October 2006), 12-7.

¹² Kotter, 21

¹³ Kotter, 16.

There were three hypotheses tested as part of this research. The first; the US Army will transition its fleet of ground vehicles to electric engines, but the process will require visionary leadership. The second; the advantages of powering vehicles without fossil fuels will outweigh the effort required to change the force. The last one; the US Army is an institution that is resistant to change, but lessons from historical military and private industry can be applied to ease the transition.

There was one primary and two secondary research questions that helped guide this research. The primary question was; what lessons can the US Army adopt from previous ground transportation evolutions to help determine the best approach during the change from fossil fuel engines to electric power? The secondary questions were what can the US Army learn from the military leadership and economic drivers required to transition the US Army from horses to motorized vehicles during the inter-war period? The last question was; what lessons can the US Army learn from Tesla's marketing and management to change the perception and efficacy of electric vehicles? By answering these questions, this research hopes to explain how the US Army could improve its current modernization trajectory and solve some of the most troublesome of its operational reach problems.

This study used the interwar period between 1920 and 1941 to examine the transition from horses to motor engines within the US Army. Concerning the private industry, the case study examined Tesla Motors between 2003 and 2012. Specifically, Tesla Motor's strategy to gain public acceptance of electric vehicles before the release of the Model S. use past tense.

This study was organized into six sections. The first section was the introduction, which comprised the basis for the study, and an overview of the research questions. The second section was the literature review, which briefly summarized the relevant extant literature covering organization culture, examining philosophical differences between military culture and the culture of technology developers. The third section was the methodology section, which included a breakdown of the structured, focused case study methodology, which was used to examine the

two case studies. Section four was a case study of the US Army's transition to motor engines from horses. Section five examined a case study of Tesla Motors and its corporate board's efforts to influence the acceptance of electric vehicles by the buying public to release the Model S. Finally, section six included the analysis and conclusions drawn from the study.

Literature Review

Introduction to Organizational Theory and Change

The study of organizational culture gained prominence during the 1930s when Kurt Lewin began to study social psychology.¹⁴ Lewin showed there were more effective means of management for individuals than the commonly accepted scientific management. Frederick Taylor's Scientific Management Theory had claimed the needs of laborers and supervisors were resolved by increasing efficiency; however, Lewin's ideas contrasted Taylor.¹⁵ Lewin argued that to effectively manage groups of individuals and change organizations, the human aspect needed to be considered.¹⁶ According to Lewin, social relationships and the ability to communicate were vital to the success or failure, and these relationships created organizations.

Since Lewin, psychologists, scientists, and executives have approached the counter-enlightenment ideas of organizational culture to understand and improve efficiency.¹⁷ While others have expanded upon Lewin's identification of social subcultures to explain their existence, Mary Jo Hatch described the genesis of organizational theory differently. Her theory claimed that it developed around phenomena of interest rather than a need for functionality.¹⁸ Re-framing subcultures again, Peter Berger and Thomas Luckman theorized there were multiple levels of socialization that occurred to indoctrinate an individual into a culture.¹⁹

¹⁴ Clem Adelman, "Kurt Lewin and the Origins of Action Research," *Educational Research* 1, no. 1 (1993): 7.

¹⁵ Edwin Locke, "The Ideas of Frederick w. Taylor: An Evaluation," *Academy of Management Review* 7, no. 1 (1982): 15.

¹⁶ Adelman, "Kurt Lewin," 7.

¹⁷ Mary Jo Hatch, *Organizational Theory: Modern, Symbolic, and Postmodern Perspective*, 4th ed. (Oxford, United Kingdom: Oxford University Press, 2018), 3.

¹⁸ *Ibid.*, 8.

¹⁹ Peter Berger and Thomas Luckman, *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*, 2nd ed. (New York, NY: Anchor Books, 1989), 163.

According to Berger and Luckman, an individual's primary socialization occurred when their family indoctrinated a member of a group into society. Primary socialization regarded general and national levels of identity.²⁰ Secondary and tertiary levels of socialization occurred as adults entered smaller and smaller sub-groupings of society.²¹ Examples of secondary socializing institutions could be a specific university, a commercial company, or a military organization. These instances of secondary socialization are examples of organizational culture relevant to this study.

To simplify the broad concepts of Berger and Luckman, Edgar Schein described culture from a functional perspective. He believed there were three layers of culture; artifacts, espoused beliefs and values, and basic underlying assumptions.²² Artifacts were the visible demonstrations of views, whereas espoused beliefs and underlying assumptions were more self-explanatory. Berger and Luckman focused primarily on Schein's third layer of organizational culture. Schein also differed in how he described how these layers affected each other. He believed that the leader of an organization subconsciously drove subordinates to develop a culture based on their vision and theories.²³ While focused on higher-level corporate structures, Schein disagreed with Taylor's scientific management. He believed there was an equal, if not more significant emphasis on how a leader found something should be done, not just its scientific efficacy. Schein emphasized that if the leader maintained the humility to learn, he could foster a learning organization.²⁴

²⁰ Berger and Luckman, 130.

²¹ Ibid., 138.

²² Edgar H. Schein, *Organizational Culture and Leadership*, 5th ed. (Hoboken, NJ: John Wiley and Sons, Inc, 2017), 18.

²³ Ibid., 131.

²⁴ Ibid., 343.

Kotter took a more aggressive theoretic stance than Schein and proposed the eight-step model for organizational change. Like Schein, he emphasized the importance of the leader to leverage their influence on an organization proactively.²⁵ The executive needed to highlight their vision at all times to generate change, and they needed to be supported by the weight of a coalition to effect lasting change.²⁶ Kotter believed active leadership could change an organization's socialization while mitigating Berger and Luckman's theory's hypothesized cognitive challenges.²⁷ Divergent and convergent opinions on organizational change were used to describe the military, and subsections of the commercial industry.

Military Organizational Change

Examined through the lens of Schein, the US Army could consider its doctrine as its espoused beliefs.²⁸ Doctrine acts as a repository of best practices for the US Army, and a recommended starting point to develop sound fundamentals. Stephen Harris hypothesized that US Army doctrine was an instrument of change in itself, submitting doctrine as a replacement for active leadership.²⁹ Harris believed that because doctrine alone did not change the artifacts and physical actions of the US Army, lazy administration increased the US Army's ability to resist change.³⁰ This analysis roughly agrees with Schein's identification of potential conflicts between artifacts and espoused beliefs, and Kotter's study of leadership as the driver of organizational change.

²⁵ Kotter, 16.

²⁶ Kotter, 21. Ibid., 21

²⁷ Berger and Luckman, 156

²⁸ Schein, 18

²⁹ Harris Stephenson, "Mission Command-Able? Assessing Organizational Change and Military Culture Compatibility in the US Army," *Journal of Military and Strategic Studies* 17, no. 1 (2016): 107.

³⁰ Ibid., 108.

Based on Kotter's articulation of change, the US Army should be uniquely suited to adopt his model. According to Arita Holmberg and Aida Alvinus, the US Army's hierarchal chain of command simplified power relationships.³¹ The US Army's ADP 6-22: *Army Leadership* highlighted that leading soldiers through change is one of the core competencies of an army leader.³² However, some of the resistance to change within the US Army may be due to a lack of desire to accept new paradigms. In Hew Strachan's *Direction of War: Contemporary Strategy in Historical Perspective*, he identified that the US Army has an organizational reticence to adapt itself to fight anything other than a short decisive war.³³ Strachan believed that despite total wars being the exception rather than the rule, the US Army naturally pursued the cultural ideal of fighting a total war.³⁴ The inherent desire amongst the soldiers and leadership to be something other than a constabulary force has prevented the army from acknowledging the environmental requirements to change.

Holmberg and Alvinus described the military as a meritocracy.³⁵ The complexity of the meritocracy system is that its benefits, promotions, or rewards, generally went to those most aligned with the organizational culture. Holmberg and Alvinus identified that militaries have a wartime and peacetime culture.³⁶ The dichotomy of militaries' different internal cultures created confusion and contradiction during efforts to change. The duality of a military meritocracy highlighted the difficulties in aligning a Kotter-esque vision of change. This could also explain

³¹ Arita Holmberg and Aida Alvinus, "How Pressure for Change Challenge Military Organizational Characteristics," *Journal of Military and Strategic Studies* 19, no. 2 (2019): 134.

³² US Army, *Army Leadership*, 7.

³³ Hew Strachan, *The Direction of War*, 4th ed. (Cambridge, UK: Cambridge University Press, 2014), 18.

³⁴ *Ibid.*, 18.

³⁵ Holmberg and Alvinus, "How Pressure for Change," 134.

³⁶ *Ibid.*

why it is more likely for an army to fight in a manner supportive of their culture when it runs counter to their doctrine.³⁷

Macgregor Knox and Williamson Murray hypothesized that western armies changed rapidly.³⁸ They believed that western armies leveraged discipline, technologic revolutions, and the concept of total destruction of their enemies. Wide-scale incorporation of new technology, executed faster than their adversaries, gave western militaries a decisive advantage.³⁹ This theory did not account for peacetime army activity. Knox and Murray's argument was specific only to the total war concept that Strachan proposed was where the US Army's organizational culture naturally reverted.⁴⁰

Richard Hundley conducted an in-depth study of the implementation of new military means, specifically the Knox and Murray referenced revolutions in military affairs. Generally categorized as new technology that affected battlefields, he looked at aspects that supported or prevented revolutions in military affairs from having an impact. Hundley identified three broad requirements, which, when aligned, would support a new piece of original equipment.⁴¹ These components were the technology itself, the doctrine to describe its use, and an organization supportive of change.⁴² The organization needed to have a receptive climate for change,

³⁷ Paul Johnston, "Doctrine Is Not Enough: The Effect of Doctrine on the Behavior of Armies," *Parameters* (Autumn 2000): 30.

³⁸ MacGregor Knox and Williamson Murray, *The Dynamics of Military Revolution, 1300–2050* (Cambridge, UK: Cambridge University Press, 2001), 54-55.

³⁹ Knox and Murray, 54-55.

⁴⁰ Strachan, 18.

⁴¹ Richard O. Hundly, *Past Revolutions and Future Transformations: What Can History of Revolutions in Military Affairs Tell Us About Transforming the U.S. Military?* (Washington, DC: National Defense Research Institute, 1999), XIV.

⁴² *Ibid.*

providing the creative freedom to envision new technologies doctrine, and the authority to approve it.⁴³ According to Kotter, its leaders should create this climate.

Technology Industry Theory

While the US Army derives most of its doctrine on organizational culture from the civilian world, the core motivations of the technology industry remain philosophically different. American industry developed separate governing theories based on the structure of capitalism. Central to these is the hard-Darwinian approach of Schumpeter's 'creative destruction.'⁴⁴ The theory of creative destruction posed that the old monoliths would be subsumed by newer ideas that are more effective, a concept that runs counter to generally accepted military ideology and acquisition.⁴⁵ Erwin Danneels molded this idea into a unique definition of disruptive technologies.⁴⁶ A newer expansion of creative destruction, disruptive technologies displaced the previous competitors, and fundamentally changed the base of the industry; and the measures of performance associated with them. This description of disruptive technology is itself an expansion of Clayton Christensen's idea of disruptive innovation where a newer, less expensive, or more accessible good enters the market to dominate the commercial niche.⁴⁷

The American technology sector's organizational culture changed to reflect a fear of being overtaken by a competitor's product. Boston College professors Gerald C Kane and John Gallagher, attempted to describe the culture of Silicon Valley by visiting twenty-four of the top-

⁴³ Ibid., XX.

⁴⁴ Joseph Schumpeter, *Capitalism Socialism and Democracy* (New York, NY: George Allen & Unwin Ltd, 1994), 83.

⁴⁵ Brett Steele, "Military Reengineering Between the World Wars" (Corporate Monograph, Santa Monica, CA, National Defense Research Institute), 60.

⁴⁶ Erwin Danneels, "Disruptive Technology Reconsidered: A Critique and Research Agenda," *Journal of Product Innovation and Management* 7, no. 2 (2004): 246.

⁴⁷ Clayton Christensen, "Disruptive Innovation," *Christensen Institute*, 2019, accessed December 22, 2019, <https://sloanreview.mit.edu/article/the-silicon-valley-caravan-what-sets-the-tech-upstarts-apart/>.

performing companies of Silicon Valley in 2017.⁴⁸ They deduced that while their espoused perceptions differed, there was a deep underlying concern for the future. Each industry they visited saw themselves as a target for future disruption. Their analysis echoed Schein's difference between espoused and underlying beliefs.

Michal Porter attempted to reduce the complexity of business strategy down to five factors in 1979.⁴⁹ These factors were the bargaining power of the buyers, the bargaining power of the suppliers, the threat of substitute products, the risk of new entrants, and the rivalry among existing competitors.⁵⁰ Disruptive technologies would specifically concern the last three elements of Porter's competition, echoing the fears observed by Kane and Gallaugh. Anna Lee Saxenian theorized that this overt focus on being replaced came from Silicon Valley's secondary socialization within the industry.⁵¹ She hypothesized that major businesses on the east coast, including many larger military contractors, centralized control, providing a more monolithic and stable but less adaptive organizational structure. West coast technology companies dispersed, making them less structured, but more adaptable to change. West coast company's smaller individual nature provided flexibility but had a higher probability of being consumed by commercial Darwinism.⁵² The London Economist concluded that this culture led the general identity of the Silicon Valley technology industry to be more risk accepting, tolerant of betrayal, and incredibly focused on improving their products to survive within a niche.⁵³

⁴⁸ Gerald Kane and John Gallaugh, "The Silicon Valley Caravan: What Sets the Tech Upstarts Apart?" *MIT Sloan Management Review*, June 6, 2017, accessed November 13, 2019, <https://sloanreview.mit.edu/article/the-silicon-valley-caravan-what-sets-the-tech-upstarts-apart/>

⁴⁹ Michael Porter, "The Five Forces," *Harvard Business School Institute for Strategy and Competitiveness*, 2019, accessed October 28, 2019, <https://www.isc.hbs.edu/strategy/business-strategy/Pages/the-five-forces.aspx>.

⁵⁰ Ibid.

⁵¹ Christopher Kelly, "Book Note Culture and Competition in Silicon Valley and Route 128: Regional Advantage," *Harvard Journal of Law and Technology* 8, no. 2 (1995): 522.

⁵² Kelly, "Book Note," 524.

⁵³ "Vital Intangibles," *The Economist; London* 342, no. 10 (March 29, 1997), 7.

Schein conducted multiple case studies on private industry, including the technology sector. While the chief executive officers he observed had leadership theories that varied between Lewman and Taylor, his studies emphasized the importance of leadership.⁵⁴ Good leadership in all circumstances was required to manage companies through the challenges of capitalism, and the innate fear of the technology industry.

After examining theory, history, and their modern executions, several patterns in organizational culture have emerged. First, there is an emphasis on leadership for creating and changing corporate culture. An organization required a leader, and its principles influenced the whole group. Second, outside of leadership, the competitive environment had the most significant influence on organizational culture. An organization's beliefs were bound by external concerns and the vision of its leader. Finally, the most successful corporate cultures were able to change and adapt to fit their current challenges. Improperly aligned cultural ideals limited the ability of a group to accomplish its mission.

⁵⁴ Schein, 146.

Methodology

This was a qualitative research project that used Andrew Bennett and Alexander George's structured, focused comparison approach. The structured focused comparison method allowed the case studies to be structured through a lens of four general research questions, while remaining focused by only considering aspects of the case studies that concerned organizational change.⁵⁵ The structured focused comparison questions were asked in support of primary and secondary research questions. The primary research question was: what lessons can the US Army adopt from previous ground transportation evolutions to help determine the best approach during the change from fossil fuel engines to electric power? The secondary questions were what can the US Army learn from the military leadership and economic drivers required to transition the US Army from horses to motorized vehicles during the inter-war period? The last research question was; what lessons can the US Army learn from Tesla's marketing and management to change the perception and efficacy of electric vehicles?

To answer the research questions the following structured focused comparison questions were asked of each case study: the first question was, what created the need for organizational change? The second question was, what economic factors supported the organizational change? The third question was, what were the principal arguments against organizational change? Finally, how did leadership overcome resistance? A review of the extant literature was conducted to gather the sources necessary to answer these questions.

This study chose two different case studies to research; the US Army's shift from horses to motorized vehicles, and Tesla Motors marketing influence before releasing the Model S. These two case studies were selected because they illustrated an Army and private business example of successful organizational change to support a paradigm shift in transportation technology. The

⁵⁵ Andrew Bennett and Alexander George, *Case Studies and Theory Development in the Social Sciences*, (Cambridge, MA: MIT Press, 2005), 70, Kindle.

US Army has signaled that it intended to adopt electric vehicles; these case studies showed examples of how to change minds to accept new technologies. First, the shift from horses to motorized vehicles represented a significant paradigm change for the US Army's method of transportation, affecting the US Army's entire doctrine, organization, training, material, leadership, personnel, and facilities infrastructure. The second case study showed how effective marketing and management could change the perception and efficacy of electric vehicles. Tesla's board re-imagined a vision of what an electric vehicle was capable of affecting the buying market. By extension, the US Army may need to conduct a similar campaign to gain the trust of the soldiers whose lives may be dependent on an electric combat vehicle.

The data was gathered primarily through research libraries and public scholarly journals. Most of the literature used was from secondary sources written for publication by the industry and the academic world, with a small amount derived from primary sources writing in social media. The first case study relied heavily on articles from military and scholarly journals as well as historical texts documenting the military transitions during the interwar period, primarily focused on motorization, and the US Army's modernization after 1939. Most of the articles were found online and at the Fort Leavenworth Combined Arms Research Library. For the second case study, the backbone of the research literature came from scholarly journals concerning fuel and energy. Other sources were gathered from newspaper articles written about Tesla Motors. Finally, primary sources from Tesla Motors Chief Executive Officer Elon Musk. This was gathered from his public writings and his social media accounts.

These sources were used to characterize the changes that the American buying public and the US Army underwent during their iterative organizational transformation. Both showed the challenges of effecting organizations' behavior and perceptions while providing context for how leaders developed solutions. From the collected literature, the study attempted to understand the culture of the times and the factors that affected it.

Case Study One: From Horses to Motors

The US Interwar Period, which lasted from 1919 to 1941 was a period of transition for the US Army. Technology developed at an impressive rate, pushing the boundaries of motorization from its infancy in World War One, to the instrument of continent-spanning conflict in the 1940s. There were a series of factors that pushed the US military to shift from horse-powered methods of movement and maneuver to motorization. These factors included the lessons learned in World War One, advances in vehicle technology from US industry, and the seething flames of conflict in Europe that began in the late 1930s. While no one factor maintained pre-eminence throughout the interwar period, each played a role in setting conditions for leaders to modernize and transition their forces. While a large portion of the US Army was resistant to new technology and doctrinal changes, US Army Chief of Staff General George Marshall played a decisive role in providing the Army the vision, structure, and trust it required to become an effective mechanized force in World War Two.

Question One: What created the need for organizational change?

Coming out of World War One, the United States and the world had learned some costly lessons about the importance of combined arms maneuver.⁵⁶ By combining armored forces with indirect fire and infantry, the stalemate of trench warfare had been overcome.⁵⁷ Two new schools of thought emerged concerning armored and motorized combat. These two concepts manifested during the early 1920s in the form of *Field Service Regulations Operations (FM 100-5)* and the *Manual for Commanders of Large Units*.⁵⁸ While *FM 100-5* emphasized tanks as a supporting element to infantry assaults, the *Manual for Commanders of Large Units* depicted armored

⁵⁶ Knox and Murray, 132.

⁵⁷ Ibid.

⁵⁸ Allen R. Millet and Williamson Murray, *Military Effectiveness, Volume 2: The Interwar Period*, 2nd ed. (New York, NY: Cambridge University Press, 2010), 90.

elements on the battlefield acting as an independent striking force conducting exploitations and penetrations.⁵⁹ While *FM 100-5*'s Infantry-centric focus later became problematic for motorization efforts, both doctrinal concepts emphasized the necessity of motorized combat vehicles on the battlefield.

Despite the acknowledged importance of motorized armored vehicles, little progress was made to adopt US Army fighting vehicles during the 1920s.⁶⁰ Despite the lessons learned from the previous war, it was not until 1930, with the establishment of a permanent mechanized force, that the US Army began to look for replacements for horse cavalry.⁶¹ This shift in focus was grudgingly accepted in the US Army because of advances in the British Army's mechanized capabilities in 1927.⁶² While British people were as war-weary as the Americans, their military leadership remembered the lessons from World War One. The British Army's demonstrated proficiency with armored forces influenced the US Army's adoption of motorized troops.

By the late 1930s, the conflict in Europe was creating a crisis that had the power to shift the US paradigms of horses and motorized vehicles. While this would be more visibly manifest in the leader of the transition, its environmental effects enabled that leader to operate. The conflict in Europe officially transitioned to an inevitable war in 1939 when Nazi Germany invaded Poland.⁶³ While the US Government was aware that Germany intended to continue to expand, Poland served as a wakeup call to the US Army. Large scale efforts to re-evaluate the US Army's fleet of vehicles and reliance on horses only began after the Nazis demonstrated mechanized

⁵⁹ Millet and Murray, 90.

⁶⁰ David E Johnson "From Frontier Constabulary to Modern Army" in *The Challenges of Change: Military Institutions and New Realities 1918-1941* (Edited by Harrold Winton and David Mets, Omaha, NE: University of Nebraska Press (May 2003)) 162.

⁶¹ Johnson "From Frontier Constabulary to Modern Army," 190.

⁶² John J. McGrath, *Scouts Out! The Development of Reconnaissance Units in Modern Armies* (Fort Leavenworth, KS: Combat Studies Institute Press, 2008), 52.

⁶³ Johnson "From Frontier Constabulary to Modern Army," 191.

strength in Poland.⁶⁴ The US Army's re-engineering included a doctrinal update to the 1920's Field Service Regulations revised in 1939 and 1941.⁶⁵ The new service regulations emphasized the importance of a free striking armored force not directly tied to infantry operations.⁶⁶ With that, the approval for a complete transition from horses was finally accepted.

Question Two: What economic factors supported organizational change?

On the technical side, the US enjoyed a marked advantage in motorization. When compared to other nations, it was home to arguably the most significant automobile industry in the world. While the military had generally conducted unilateral development of equipment, during the 1920s, the US Army had collaborated with the Society of American Automotive Engineers. This benefitted the US Army in both its ability to develop requirements for new motorized equipment and increased the extant expertise for them to draw upon. Where complaints from those resistant to change revolved around motorized vehicles inferiority to horses, the partnership between the US Army and industry enabled capability development to iron out issues incrementally. This iterative improvement coincided with Steele's belief that technology needs to be improved in leaps and spurts to meet the demand of the units in the field.⁶⁷ The infrastructure for vehicles grew drastically during this window. Due to the growing availability of fuel, and the reliance on motor vehicles, US petroleum consumption more than doubled between 1920 and 1940.⁶⁸

⁶⁴ Johnson "From Frontier Constabulary to Modern Army," 191; Steele, "Military Reengineering," 64

⁶⁵ Johnson "From Frontier Constabulary to Modern Army," 181.

⁶⁶ Ibid.

⁶⁷ Steel, "Military Reengineering," 32.

⁶⁸ Murray Foss, "Changing Patterns of Fuel Consumption," Survey of Current Business, US Department of Commerce (July 1948): 7.

Despite these advances, some significant economic realities slowed motorization. The 1920s were a time of austerity for the military following World War One.⁶⁹ The great depression compounded these problems as the nation moved into the 1930s.⁷⁰ In 1928, \$600 was enough to purchase the horses needed for a four-person patrol.⁷¹ During the 1930s, a new tank was priced at \$30,000 without factoring in a research budget.⁷² There were significant economic reasons for the US Army to search for alternatives to modernizing and adopting armored forces. Congress pointed to the surplus of available, but outdated World War One tanks as a cheaper alternative to modernization.⁷³ In this resource-constrained environment, the US Army decided to fund human resources rather than technological development.⁷⁴

Another economically driven factor was the US Army Ordnance Corps. The Ordnance Corps was struggling to streamline a process to maintain armories, which included tanks.⁷⁵ The US Army had the support of the Society of American Automotive Engineers, but the Ordnance Corp was responsible for finding a cost-efficient design to create. Any tank created needed to be below a standard weight of fifteen tons, or it would be unable to cross a waterway on the US Army's existing pontoon bridges.⁷⁶ This further complicated development by forcing the Ordnance Corps to either rebuild their pontoon bridges, design lighter, less durable tanks, or build

⁶⁹ Norwich University Online, "Isolationism and U.S. Foreign Policy After World War I," *Norwich University*, November 6, 2017.

⁷⁰ Millet and Murray, 85.

⁷¹ Daley, "Patton Versus the "Motor Maniacs," 14.

⁷² Ibid

⁷³ Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington, DC: Department of the Army, Historical Division, 1950), 33.

⁷⁴ Steele, "Military Reengineering," 16.

⁷⁵ Ibid.

⁷⁶ George F. Hoffmann, "The Demise of the U.S. Tank Corps and Medium Tank Development Program," *Military Affairs* 37, no. 1 (February 1973): 24.

a tank without a critical piece of equipment to exploit its mobility in Europe. There was no unifying vision or voice to break the gridlock until 1939.

Question Three: What were the principal arguments against organizational change?

Immediately following World War One, General John J. Pershing was serving as the Commander of the American Expeditionary Forces. He found himself required to answer for the costs of the war to Congress.⁷⁷ To prepare, he ordered a series of boards to assess the US Army's performance that culminated in the Superior Board of 1919.⁷⁸ The boards discarded multiple controversial motorization issues. The emergence of tanks on the battlefield had caused the infantry-centric Pershing to take issue with the idea of equipment supplanting the capability of infantry. The Tank Corps was an implicit threat to the structure of the US Army in 1919.⁷⁹

With General Pershing in the lead, the 1919 Superior Board reached a troublesome series of conclusions, which seemed to echo the Franco-Prussian War, rather than the Great War. The board affirmed the belief battles would be won through the spirit of the offense and the individual rifleman's aggressiveness, despite the advent of armor, machine guns, and gas.⁸⁰ The infantry again ascended to be the primary wing of the US Army, with all other service components as supporting efforts. The infantry branch absorbed the Tank Corps, where the bulk of the armored and motorized forces were organized.⁸¹ In 1920, the National Defense Act implemented the

⁷⁷ Hoffmann, "The Demise of the U.S. Tank Corps," 20.

⁷⁸ Johnson "From Frontier Constabulary to Modern Army," 167.

⁷⁹ Steele, "Military Reengineering," 17.

⁸⁰ Johnson "From Frontier Constabulary to Modern Army," 167-168.

⁸¹ Hoffmann, "The Demise of the U.S. Tank Corps," 21

majority of the Superior Board's recommendations, officially returning the US Army to its pre-World War One structure.⁸²

While the National Defense Act of 1920 did not intend to prevent motorization, the net result stymied armored growth. The recommendations from the board were not surprising when attributed to the military's cultural fear of deviation from tried and true methods.⁸³ Though tanks were battle-tested, the military's inability to adopt creative destruction at the cost of the old standard crippled tank development for almost two decades.

Further, intermingling armor and infantry personnel under the infantry branch allowed petty rivalries to manifest as the infantry branch enforced a rigid hierarchy.⁸⁴ The US Army officially hamstrung itself from metabolizing the hard lesson they had bled to learn. In typical form, the peacetime Army was reticent to change their culture without an urgent operational requirement.⁸⁵

Other detractors within the US Army Cavalry were actively working to undermine the adoption of armor. Rather than fear for their soldiers, these individuals were motivated by the desire to hold on to old ineffective 'glory days.'⁸⁶ This effect was more pronounced within the US Cavalry, but still present within the Infantry.⁸⁷ Throughout the 1920s, multiple cavalry officers recognized that modern weapons were better mitigated by plated steel than horseflesh.⁸⁸ Unfortunately, more than any other branch of the US Army, the cavalry was mired in tradition.

⁸² Millet and Murray, 82.

⁸³ Suzanne Nielsen "An Army Transformed: The U.S. Army's Post-Vietnam Recovery and the Dynamics of Change in Military Organizations" Carlisle, PA: US Army War College, 2010: 112.

⁸⁴ Hoffmann, "The Demise of the U.S. Tank Corps," 20.

⁸⁵ Stephen Peter Rosen, *Winning the Next War*. (Ithaca, NY: Cornell University Press, 1991), 8, 69-71.

⁸⁶ Nielsen, "An Army Transformed," 112.

⁸⁷ Johnson "From Frontier Constabulary to Modern Army," 188.

⁸⁸ Daley. "Patton Versus the "Motor Maniacs,"13.

Parting the cavalry from their mounts would have been considered a paradigm shift too dramatic to handle for the US Army of the 1920s, despite advantages even their senior officers identified.⁸⁹

In their defense, motor vehicles of the 1920s had not fully evolved, nor had their requisite infrastructure. General George Patton made valid arguments against the immediate shift to motorized vehicles, expressing fears that faulty technology would leave scouts crippled in enemy territory.⁹⁰ As the technology progressed, however, the reticence of the cavalry to accept the capability of motorization contorted their logic into some truly backward doctrine. In the late 1930s, Chief of the Cavalry General John Herr supported a doctrine that would truck horses to the battlefield due to their limited range in mobile warfare.⁹¹ Similar problems of doctrine had evolved within the US Infantry. However, these may have been more mired in the distinction between operational necessity and tactical victory than an unwillingness to adapt.⁹² Still, the organizational structure of the military, which placed the Tank Corps under the control of the Infantry, had both tactical and financial incentives to discourage the support of armor within their ranks.⁹³

Question Four: How did leadership overcome resistance?

The inefficiencies of an Army dominated by the branch chief's competition for funding and control had been apparent since the 1920 National Defense Act. As the US entered the late 1930's, and the threat of a new war in Europe began to reveal the paradigm-shifting crisis it would become, the situation was ripe for a leader to seize the moment to create lasting organizational change. That leader was General George Marshall, who became the US Army

⁸⁹ Johnson "From Frontier Constabulary to Modern Army," 188.

⁹⁰ Daley. "Patton Versus the "Motor Maniacs," 13.

⁹¹ Johnson "From Frontier Constabulary to Modern Army," 188.

⁹² Millet and Murray, 91.

⁹³ Hoffmann, "The Demise of the U.S. Tank Corps," 22.

Chief of Staff in 1939.⁹⁴ The situation became a crisis when Hitler's armor forces advanced across Poland in September 1939. Hitler's armor highlighted the utility of motorization and America's unpreparedness.⁹⁵ Capitalizing on this sense of urgency, Marshall used recognizable elements of Kotter's Change Model and Hundley's rules for using revolutions in technology to change the US Army's organization.⁹⁶ Marshall anchored his forces' experiences in challenging maneuver training, developing his soldier's confidence in the new technology, and refining the doctrine to maximize the use of mobile motorized forces.

On September 5, 1939, four days after Hitler's Army entered Poland, President Roosevelt declared a national state of emergency, and the US Army found itself awash with funding.⁹⁷ General Marshall helmed the US Army's redesign and began to centralize control to enable modernization efforts. During this window of opportunity, Marshall deftly executed a Kotter-esque plan to create lasting change within the US Army. Under the crisis of a resurgent Germany, Marshall immediately released his vision of the future force, one that would have an expansive and capable mechanized arm. Marshall put \$12,000,000 into the modernization of US Army tanks while demanding outdated horse units turn in their mounts and begin the process of motorization.⁹⁸

Marshall implemented a series of maneuvers between 1940 and 1941 to test his new military concepts, and to gain the trust of subordinate commanders.⁹⁹ During September 1940,

⁹⁴ Watson, 8.

⁹⁵ Ibid., 159.

⁹⁶ Richard O. Hundly, *Past Revolutions and Future Transformations: What Can History of Revolutions in Military Affairs Tell Us About Transforming the U.S. Military?* (Washington, DC: National Defense Research Institute, 1999), XIV; John P. Kotter, *Leading Change*, (Boston, MA: Harvard Business School Press, 1996), 21.

⁹⁷ Watson, 157.

⁹⁸ Ibid., 157-158.

⁹⁹ Kenneth J. Hagan and William R. Roberts, *Against All Enemies: Interpretations of American Military History from Colonial Times to the Present*, (Westport, CT: Greenwood Publishing Group, 1986), 280.

Marshall's massive field maneuvers tested the capability of two field armies and included over 400,000 men.¹⁰⁰ The following year he implemented a smaller series of maneuvers but explicitly focused on the previous year's deficiencies. Throughout these exercises, Marshall messaged his vision of what the military was to become and challenged his men to use the new equipment.¹⁰¹ This communication went both to his subordinate military commanders, as well as to congressional oversight committees.¹⁰²

Marshall observed the progress of his plan and handpicked officers who adapted well to the pace and speed of mobile warfare. Some of the officers he selected to join his guiding coalition were Dwight Eisenhower, Omar Bradley, and George Patton.¹⁰³ On the opposing side, Marshall did not hesitate to force officers into retirement if they could not adapt to the new Army.¹⁰⁴ Most notable was Major General Herr. Marshall forced Herr into retirement, and the position of the Chief of Cavalry retired with him.¹⁰⁵

In executing these large-scale training maneuvers in 1940 and 1941, Marshall gained short term wins for motorization. Tanks operated well on these training grounds, leading subordinate commanders to trust them in combat. In 1940, the US Army's leadership accepted the versatility of a special striking force of armored cars, which led to the rewriting of the *Field Service Regulations*.¹⁰⁶ Actions like these enabled Marshall to build on his efforts and anchor his

¹⁰⁰ Watson, 239.

¹⁰¹ Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington, DC: Department of the Army, Historical Division, 1950), 7; Thomas Ricks, "Lose a General, Win a War," *New York Times*, June 24, 2010.

¹⁰² Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington, DC: Department of the Army, Historical Division, 1950), 7; Thomas Ricks, "Lose a General, Win a War," *New York Times*, June 24, 2010.

¹⁰³ Hagan and Roberts, 280.

¹⁰⁴ Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington, DC: Department of the Army, Historical Division, 1950), 7; Thomas Ricks, "Lose a General, Win a War," *New York Times*, June 24, 2010.

¹⁰⁵ Ibid.

¹⁰⁶ Johnson "From Frontier Constabulary to Modern Army," 181.

short-term successes in US Army culture to create lasting change and prepare for the coming war. By the end of Marshall's modernization efforts in 1942, the US Army had created new doctrine to support motorized and mobile warfare, had built newer, more modern motorized weapons, and had emplaced the leaders who could best leverage their lethality.

Summary

As straightforward and organic as the US Army's shift away from horses may seem, there were external and internal cultural conflicts that prevented the immediate adoption and production of motor vehicles for the US Army. Some of these problems stemmed from the US Army's failure to learn the lessons of World War One. Other problems stemmed from a belief in the supremacy of honor, legacy, and the myth of the 'good old days.' Some of these problems emerged because of fiscal reality, and a public unwilling to foot the bill. Regardless, the path that led the US Army from the inroads of motorization in World War One to the fully mechanized force that entered World War Two was a long one.

Motorization started of necessity before either the technology was fully mature, or the fueling infrastructure was available but was buoyed by technological advancements in private industry. Despite the organic developments, there were severe cultural roadblocks within the US Army, where senior leaders defended their spheres of influence at the cost of efficiency. Marshall's intervention was sparked by necessity but used the wave of technologic advancement that occurred within the civilian sector to update and field-test concepts. The communication of his vision, coupled with his use of field exercises, built the trust within the organization for him to overcome obstacles and implement a redesign of the US Army's maneuver forces. Marshall's leadership through organizational change still holds poignant lessons as the US Army continues to transition.

Case Study Two: The Road to the Model S

Tesla Motors' Model S was one of the first examples of a viable everyday electric vehicle. Finished in 2012, the Model S was the most highly reviewed luxury vehicle of the decade.¹⁰⁷ Tesla Motors' education of the public and the influence of their perception of electric vehicles leading to their release of the Model S were anything but accidental. Tesla Motors was created to reframe the image of the electric car.¹⁰⁸ The company used the lack of competition in the electric vehicle space, and the rising cost of oil, to solidify a position in the market. They also re-imagined what a battery-powered vehicle was capable of.

Tesla Motors' engineers created luxury performance vehicles that happened to run on electricity. This focus on quality and iterative improvement allowed Tesla's board to shape how Americans perceived electric vehicles. Tesla Motors' owner Elon Musk developed the focus and vision of the company and consistently publicized his message. While the company took on a significant amount of debt leading to the release of the Model S, the re-invention of the electric vehicle to meet consumer demand, and the consistency of brand message for the Model S was masterfully done.¹⁰⁹

Question One: What created the need for organizational change?

Martin Eberhard and Marc Tarpenning, two California based engineers, founded Tesla Motors in 2003.¹¹⁰ Unlike their competitors, Eberhard and Tarpenning founded Tesla Motors to

¹⁰⁷ Tamara Rutter, "Why Tesla Has the Most Loyal Customers," *USA Today: The Motley Fool*, September 6, 2014, accessed December 8, 2019, <https://www.usatoday.com/story/money/cars/2014/09/06/why-tesla-has-the-most-loyal-customers/15139377/>

¹⁰⁸ Christopher McFadden, "The Short but Fascinating History of Tesla," *Interesting Engineering*, October 26, 2019, accessed December 9, 2019, <https://interestingengineering.com/the-short-but-fascinating-history-of-tesla>.

¹⁰⁹ Blake Martin, Caroline Clothiaux, and Peter Lund, "Driving Off a Cliff: The Case Against Tesla" (College Thesis, Auburn, AL: Auburn University, 2015), 3.

¹¹⁰ McFadden, "The Short but Fascinating History of Tesla."

produce electric vehicles that were not a compromise between fuel efficiency and power.

Whereas its competitors were leaning into the environmental benefits of electrification, Eberhard and Tarpinning wanted to redefine the niche as something other than a social statement.¹¹¹

During their first search for investors, wealthy entrepreneur Elon Musk invested heavily and established himself on the fledgling company's board.¹¹² Where Eberhard and Tarpinning had developed a vague company ethos, Musk recognized a gap in the market that he could exploit.¹¹³

Weighing into Musk's investment in Tesla was the lack of competition in the electric vehicle space. Before Tesla, the largest retailer of electric vehicles had been General Motors.¹¹⁴ Under a 1990 California law, car companies selling vehicles in California needed to produce a zero-emission vehicle. By 1996, General Motors began leasing the Electric Vehicle One, or EV1.¹¹⁵ The EV1 was a rather anemic entry into the market; it was capable of less than 100 miles per charge and lacked rear row seating.¹¹⁶ Further limiting its utility, General Motors produced less than 1200 of them in total.¹¹⁷ While General Motors had invested over a billion dollars in its production, they recalled all leased EV1s and canceled the program as soon as the California Law was changed in 2001.¹¹⁸ Rick Wagoner, the General Motors General Manager who made the decision, was shocked by local outrage and the bad publicity he received for a vehicle he deemed

¹¹¹ McFadden, "The Short but Fascinating History of Tesla."

¹¹² Ibid.

¹¹³ Ibid.

¹¹⁴ Oliver Staley, "The General Motors CEO Who Killed the Original Electric Car Is Now in the Electric Car Business," *Quartz*, April 7, 2017, accessed December 13, 2019, <https://qz.com/952951/the-general-motors-gm-ceo-who-killed-the-ev1-electric-car-rick-wagoner-is-now-in-the-electric-car-business/>.

¹¹⁵ Staley, "The General Motors CEO, "; James Wouldhuysen, "The Electric Car Conspiracy... That Never Was," *Register*, January 1, 2008, accessed March 31, 2020, https://www.theregister.co.uk/2008/01/01/wouldhuysen_electric_car/.

¹¹⁶ Ibid.

¹¹⁷ Ibid.

¹¹⁸ Edward Stringham, Jennifer Miller, and J.R. Clark, "Overcoming Barriers to Entry in an Established Industry: Tesla Motors," *California Management Review* 57, no. 4 (Summer 2015): 91.

a failure.¹¹⁹ Musk, aware of Silicon Valley's globalist intentions, was ready to pounce when General Motors declared the niche market a bust.¹²⁰

Question Two: What economic factors supported organizational change?

Tesla Motors' engineers were able to iteratively improve and build interest in their vehicles because of a series of lack of competition and legislative support. In 2009, President Barack Obama's administration enacted a series of national subsidies for electric vehicles.¹²¹ As part of the auto bailout package after the global financial collapse in 2008, the Obama administration approved \$2.4 billion in research grants for electric vehicles.¹²² Additionally, there was a direct to a consumer tax credit of \$7,500 allotted to the first 200,000 individuals to purchase an electric vehicle.¹²³ Near the same time, similar legislative measures were enacted in the UK, and China, expanding the Tesla market.¹²⁴

For automotive consumers, the rising cost of oil between 2003 and 2012 provided an additional incentive to switch to electric.¹²⁵ Between the 1990s and the late 2000s, the price of oil had nearly doubled within the US, and internationally the standard cost of fuel had quadrupled.¹²⁶

¹¹⁹ "Interview: Rick Wagoner, General Motors CO," *Motortrend*, 2006, accessed December 15, 2019, <https://www.motortrend.com/news/rick-wagoner-general-motors/>.

¹²⁰ Elon Musk, "Few people know that we started Tesla when GM forcibly recalled all electric cars from customers in 2003 and then crushed them in a junkyard," Twitter, June 9, 2017.

¹²¹ John S. Cunningham, "An Analysis of Battery Electric Vehicle Production Projections," Cambridge, MA: Massachusetts Institute of Technology (2009), 6.

¹²² *Ibid.*

¹²³ *Ibid.*

¹²⁴ Scott Hardman, Eric Shiu, and Robert Steinberger-Wilkens, "Changing the Fate of Fuel Cell Vehicles: Can Lessons Be Learnt from Tesla Motors?" *International Journal of Hydrogen Energy* 40 (2015): 1629; Myles Mangram, "The Globalization of Tesla Motors: A Strategic Marketing Plan Analysis," *Journal of Strategic Marketing* 20, no. 4 (July 2012): 294.

¹²⁵ Mangram, "The Globalization of Tesla Motors," 295.

¹²⁶ *Ibid.*

While oil prices had peaked at \$150 a barrel in 2008 before falling back to \$100 in 2011, economists had predicted that the price of oil would rise more than 20% the following year.¹²⁷

The high cost of oil did not immediately translate into proportional electric vehicle sales. While electric vehicles were cheaper in the end, in 2012, it took at least ten years for the fuel savings to overcome the initial purchase price of an electric vehicle.¹²⁸ Though these external governmental controls provided outliers to the combustion engine paradigm, the availability and price of electric vehicles could not create a competitive market for sale on their own. Pure economic reasoning could not overcome the cultural mistrust of electric vehicles.

Question Three: What were the principal arguments against organizational change?

Before the Model S, the American public did not see electric vehicles as fully viable. Based on their experience with other electric vehicles, Americans perceived them as risky substandard performers, and more appealing to the ‘green’ crowd.¹²⁹ There was a lack of infrastructure to support shorter-range economy electric vehicles.¹³⁰ The auto industry itself had stagnated in developing alternatives, having no incentive to compete in the electric vehicle industry.

In the United States before the Model S, the cultural perception of electric vehicles was one of either performance compromises or an environmental statement. This perception was based on their limited availability and actual poor performances prior to 2012.¹³¹ While a handful of electric vehicles were released for sale by traditional automakers in 2012, the majority had less

¹²⁷ Cunningham, “An Analysis of Battery Electric Vehicle Production Projections,” 7.

¹²⁸ Hardman, Shiu, and Steinberger-Wilkens, “Changing the Fate of Fuel Cell Vehicles,” 1629.

¹²⁹ Makena Coffman, Scott F. Allen, and Sherilyn Wee, “Who Are Driving Electric Vehicles? An Analysis of Factors That Affect Ev Adoption in Hawaii,” Honolulu, HI: The Economic Research Organization at the University of Hawaii (May 2018), 5.

¹³⁰ Dave Vanderwerp, “2011 Chevrolet Volt Full Test,” *Car and Driver*, December 2010, accessed December 15, 2019, <https://www.caranddriver.com/reviews/a15128758/2011-chevrolet-volt-test-review/>.

¹³¹ Coffman, Allen, and Wee, “Who Are Driving Electric Vehicles?” 5.

than 100 miles of range, and all had below 200 miles of range.¹³² Before Tesla Motors' innovations, the EV1 was the primary American example of the electric car. While the EV1 served an audience, its functionality and curtailed leasing left much to be desired. The EV1's spiritual successor, the Nissan Leaf released in 2010, the performance was significantly better than its decade-old peer, but it failed to attract the general public.¹³³ *Car and Driver* described it as a vehicle bound by fear, fear of running out of electricity, or failure.¹³⁴ Summarizing that while the vehicle might make an acceptable short-range second car, its ten-second 0-60 mph speed would not satisfy anyone enthusiastic about vehicles.

While researchers found it difficult to quantify the US perception of electric vehicles before the Model S' release, there were qualitative assumptions that were drawn by the profile of early adopters of electric vehicles.¹³⁵ Electric vehicle owners tended to be younger, high income earning males, with concerns for the environment and an interest in developing technology. The profile did not indicate that the American everyman was interested in battery-powered vehicles. In a case study specific to Hawaii, researchers identified that consumers did not trust electric vehicles for daily commutes longer than forty-five minutes, illustrating a more deep-seated risk aversion to them.¹³⁶ In the few years before the release of the Model S, the only waves in the electric vehicle market were caused by Tesla Motors.¹³⁷

In 2012, the US Department of Transportation (DOT) had plans to expand the prevalence of publicly accessible direct current chargers capable of providing 60-80 miles of range in less

¹³² Berg, "9 Electric Cars You Can Actually Buy."

¹³³ David Gluckman, "2011 Nissan Leaf SI," *Car and Driver*, August 25, 2011.

¹³⁴ Ibid.

¹³⁵ Makena Coffman, Paul Bernstein, and Sherllyn Wee, "Factors Affecting EV Adoption: A Literature Review and EV Forecast for Hawaii" Cocoa, FL: University of Central Florida (April 2015), 11.

¹³⁶ Coffman, Allen, and Wee, "Who Are Driving Electric Vehicles?" 5.

¹³⁷ Stringham, Miller, and Clark, "Overcoming Barriers to Entry," 92.

than thirty minutes.¹³⁸ Despite the DOT's aspirations, in the year before the release of the Model S, forty-eight out of the fifty states had fewer than ten electrical charging stations.¹³⁹ The DOT also intended to focus its efforts in areas already saturated with electric vehicles.¹⁴⁰ Fully charging an electric vehicle like the Nissan Leaf would require anywhere between four or fifteen hours at an owner's residence.¹⁴¹ The infrastructure to support cross-country travel in an electric vehicle was sorely lacking

While American consumer culture and perception created their barriers for adoption, the monolithic auto industry also faced its adaptive issues. In 1980, General Motors, Ford, Chrysler, Honda, Nissan, and Toyota were six of the top companies in vehicle sales.¹⁴² In 2015, those same companies comprised six of the seven top automotive sellers.¹⁴³ In a market where competition seemed stagnate, there was minimal onus to change. The institutions of the auto providers had thickened into less mobile and adaptive organizations. As an example of the inefficiencies of their bureaucracies in the post EV1 era, Chevrolet's leadership spent \$1.2 billion developing their electric vehicle, the Volt; and Nissan's directors devoted a stunning \$5.6 billion to release the Leaf.¹⁴⁴ These institutions in themselves were failing to provide the public with a viable option to generate change or cement the idea of the electric vehicle as anything other than a minimum performance vehicle. These organizations approached electric vehicles in a manner like the US Army's shift to motorization during the early interwar period, without a catalyzing sense of urgency. The automotive companies were dragging their collective feet. In 2009, both General

¹³⁸ Diane Turchetta, "The Car of the Future, Today," *US Department of Transportation: Federal Highway Administration Research and Technology* 76, no. 3 (November/ December 2012).

¹³⁹ Vanderwerp, "2011 Chevrolet Volt Full Test."

¹⁴⁰ Turchetta, "The Car of the Future, Today."

¹⁴¹ *Ibid.*

¹⁴² Stringham, Miller, and Clark, "Overcoming Barriers to Entry," 85.

¹⁴³ *Ibid.*

¹⁴⁴ *Ibid.*, 91.

Motors and Toyota's leaders believed that lithium battery capable cars were at least a decade away.¹⁴⁵

While there were multiple new entries of electric vehicles in 2012, most were a reaction to Tesla's innovation.¹⁴⁶ Since the end of the Korean War, the three-pronged financial drivers of university contributions, defense spending, and venture capitalism had shaped industrial and technological development on the east and west coasts.¹⁴⁷ While these led to bad habits on both coasts, regional cultures emerged that developed the perspectives of the entrepreneurs on either side. The East coast took a more hierarchical, structured, and plodding approach. The West coast leaned into the economic Darwinism model of creative destruction.¹⁴⁸ The West coast technology industry became less risk-averse and more open to failure and change, which was lucky because Musk himself believed Tesla only had a one in ten chance of success.¹⁴⁹

Question Four: How did leadership overcome resistance?

Loosely following Kotter's change model, Tesla Motors, under Elon Musk's leadership, managed to influence US cultural change via the development of a vision, effective messaging through branding, and generating more change by iterative successes. Tesla's designers created both their Roadster and the Model S for \$790 million while developing the lithium battery.¹⁵⁰ Other car companies were devoting resources towards projects not expected to yield near term results and making strategic decisions they would later regret.¹⁵¹

¹⁴⁵ Higgins, "Akerson Demands GM Innovation,"

¹⁴⁶ Tim Higgins, "Akerson Demands GM Innovation to Blunt Tesla Threat," *Bloomberg*, July 17, 2013.

¹⁴⁷ Christopher, Kelley. "Book Note Culture and Competition in Silicon Valley and Route 128: Regional Advantage," *Harvard Journal of Law and Technology* 8, no. 2 (1995): 523.

¹⁴⁸ "Vital Intangibles," 7.

¹⁴⁹ Stringham, Miller, and Clark, "Overcoming Barriers to Entry," 91.

¹⁵⁰ *Ibid.*

¹⁵¹ "Interview: Rick Wagoner"

When Elon Musk bought his way into the chief executive officer's chair on the Tesla board, he fit the electric vehicle's early buyer profile and brought that enthusiasm to the company. As Kotter noted, a leader must generate a vision to create conditions for lasting change, ideally supported by a guiding coalition.¹⁵² Kotter himself imagined this as a close-knit cadre of trusted individuals within an organization. Musk, a product of the information age, took a modern approach to receive feedback. Musk consulted the internet.¹⁵³ This deviation to incorporate new technology into his ends, ways, and means was something none of the other monolithic auto companies had attempted. In 2006, Musk publicly released the vision statement for Tesla in his ironically titled “The Secret Tesla Motors Master Plan (just between you and me)” that would remain unchanged for the next decade.¹⁵⁴ His plan boiled down to four goals.¹⁵⁵ First, produce an expensive limitedly available sports car that could demonstrate the cutting edge limit of the electric technology. Second, build a less expensive luxury version of that vehicle to penetrate the general automobile market. Third, further, reduce the cost of technology in an even more accessible vehicle. Fourth and finally, throughout the process, find a way to charge these vehicles without creating more emissions electrically.¹⁵⁶

Unlike the accepted standard, Musk chose to approach industry disruption from the top-down rather than from the bottom-up, and this was pivotal. Traditional industry disruption came from a low-cost item, slowly increasing their presence to replace its competition.¹⁵⁷ Using the EV1 and Leaf as case studies, Tesla Motors’ leaders decided to invert the model to fit the electric

¹⁵² Kotter, 21.

¹⁵³ Stringham, Miller, and Clark, “Overcoming Barriers to Entry,” 89.

¹⁵⁴ Elon Musk, “The Secret Tesla Motors Master Plan (Just between You and Me),” Tesla (blog), August 6, 2006.

¹⁵⁵ Ibid.

¹⁵⁶ Elon Musk, “The Secret Tesla Motors Master Plan (Just between You and Me),” Tesla (blog), August 6, 2006.

¹⁵⁷ Christensen, “Disruptive Innovation.”

vehicle industry. Musk understood that in the technologic realm, it was impossible to displace the existing incumbent by immediately going for a lower cost.¹⁵⁸ The previous non-Tesla iterations of electric cars had shown cheaper options could not reframe the psyche of the American consumer. Cost-efficient electric vehicles less expensive batteries and supporting technology were not as capable as their gas-powered competition.¹⁵⁹ To Musk, the math was easy. If significantly advanced electric engines could not be mass-produced cheaply, it made sense to produce a more expensive vehicle that could capitalize on the cutting edge of technology. It did not hurt that the electric car buyer profile was already wealthy.¹⁶⁰ With a vision and strategy in place, Tesla Motors faced the challenge of creating a brand.

To develop a following and build brand recognition, Tesla's board firmly planted itself in the realm of a technology company rather than as a new entry to the American auto industry. The branding and marketing of Tesla drew more comparisons to Apple Inc than Ford.¹⁶¹ To shape his position in the market, as well as the US auto buying culture, Musk did three important things. First, as Apple did with the PC, Musk generated urgency by creating an enemy, the internal combustion engine. Second, he established an emotional connection to influence consumer choice. Instead of solely relying on green aspects of his vehicles, Musk tied to fun and social responsibility into the core of his vehicles.¹⁶² Finally, and most importantly, Tesla Motors made every effort to listen to consumer reports and improve.¹⁶³ Tesla's management and engineers

¹⁵⁸ Hardman, Shiu, and Steinberger-Wilkens, "Changing the Fate of Fuel Cell Vehicles," 1627.

¹⁵⁹ Scott Hardman, Robert Steinberger-Wilckens, and Dan van der Horst, "Disruptive Innovations: The Case for Hydrogen Fuel Cells and Battery Electric Vehicles," *Journal of Hydrogen Energy* 38, no. 52 (November 2013): 15438.

¹⁶⁰ Coffman, Bernstein, and Wee, "Factors Affecting EV Adoption," 11.

¹⁶¹ Mangram, "The Globalization of Tesla Motors," 289.

¹⁶² Rutter, "Why Tesla Has the Most Loyal Customers,"; Mangram, "The Globalization of Tesla Motors," 296.

¹⁶³ Rutter, "Why Tesla Has the Most Loyal Customers."

continuously interacted with public feedback and complaints to iteratively address faults and improve their vehicles.¹⁶⁴

As of 2018, Tesla Motors had not spent any money on marketing, and their team shared their concept through word of mouth and social media.¹⁶⁵ Elon Musk's cult of personality as a tech industry savant and car enthusiasts enabled Tesla Motors' message to reach a broader audience. Between Musk's 17.9 million twitter followers and free media coverage, Tesla's Chief Executive Officer remained accessible to the public, while continuously advertising his vehicles personally.¹⁶⁶ Tesla Motors' brand was closely tied to Musk's inspirational vision of a better, "cooler" future.¹⁶⁷ Between Musk's communications with the public, and willingness to accept and correct problems with his vehicles, he managed to tie himself and his enthusiastic vision to his products.

While Marshall used large-scale maneuvers to test motor vehicles in 1940 and 1941, Musk remained consistent with the first milestone on his 2006 vision statement to develop a high-end sports car. The result was the Roadster released in 2008.¹⁶⁸ Built around the Lotus Elise frame, and boasting over a 200-mile range, along with a 0-60 mph speed of 3.9 seconds, the Roadster re-imagined what technology would enable an electric vehicle to become.¹⁶⁹ With a sticker price of near \$100,000 and a total production of less than 3,000, the Roadster was a minimal release. As a tool to show capability and reframe the image of electric vehicles in

¹⁶⁴ Stringham, Miller, and Clark, "Overcoming Barriers to Entry," 91.

¹⁶⁵ Anna Melton, "What Can We Learn from Tesla's \$0 Marketing Strategy?" *Data Marketing Association*, January 24th, 2018.

¹⁶⁶ Hardman, Shiu, and Steinberger-Wilkens, "Changing the Fate of Fuel Cell Vehicles," 1631.

¹⁶⁷ Josh Ong, "What Tesla's Valuation Says About the Power of Branding," *Forbes*, November 17, 2017.

¹⁶⁸ Lewis Page, "Elon Musk Hits Out at Co-Founder's Tesla Roadster Allegations," *Register*, June 23, 2009. & Bob Sorokanich, "Elon Musk Admits to Shareholders That the Tesla Roadster Was a Disaster," *Road and Track*, June 1, 2016.

¹⁶⁹ Aaron Robinson, "2012 Tesla Model S: Riding Shotgun," *Car and Driver*, October 5th, 2011.

America, the Roadster was an incredible leap forward from the EV1. The Roadster generated enormous publicity behind the Tesla public relations machine and allowed them to use its success while moving towards the Model S.

No plan is perfect, however, and Musk made some early missteps that almost destroyed the company's initial effort to release the Roadster in 2006.¹⁷⁰ With faulty safety features, constant malfunctions, and an initial sales price that was \$50,000 under the real cost of the vehicle, Tesla Motors barely avoided bankruptcy.¹⁷¹ After two additional years of development, Tesla Motors managed to fix the Roadster's technical issues, but their financial future was still uncertain. Following the Roadster's four-years of production from 2008 to 2012, Musk had to pivot Tesla Motors after realizing that the Roadster could not generate the profits necessary to keep the company afloat.¹⁷²

When Tesla Motors transitioned to producing the Model S, they were able to build on the successful image of the Roadster. Musk's message remained consistent as he turned to develop a luxury vehicle, the Model S, and the second step of his 2006 vision.¹⁷³ Musk's perfectionist attitude prevailed across the design of the Model S. Cognizant of public complaints from the Roadster and early versions of the vehicle, and Musk sought to address them all, even taking suggestions from his daughter.¹⁷⁴ The fan base he built during the lead up to the Roadster allowed him to generate publicity for the Model S. Supporters of Musk's vision were not the only ones excited about the Model S, car enthusiasts were excited by the vehicle's driving experience as well. *Consumer Reports* gave the Model S their highest score ever, 99 out of 100, with the single

¹⁷⁰ Sorokanich, "Elon Musk Admits to Shareholders."

¹⁷¹ Ibid.

¹⁷² "Tesla Roadster Production Will End Next Year," *US News and World Report*, February 1, 2010.

¹⁷³ Musk, "The Secret Tesla Motors Master Plan."

¹⁷⁴ Stringham, Miller, and Clark, "Overcoming Barriers to Entry," 91.

point lost over recharging fears.¹⁷⁵ With a base price of \$57,000, the Model S was still not going to be as ubiquitous as the Toyota Corolla, but its market share dwarfed the Roadster's limited release.¹⁷⁶ The Model S marked the first public release of a stunningly capable electric vehicle.¹⁷⁷ The culmination of nine years of effort, and many partial successes, the Model S produced rave reviews in the US as an incredible outlier to the cultural views of an electric car.

Summary

Musk's vision of electric vehicle predominance did not happen. There were still multiple iterations of development left for electric vehicle technology to reach maturity, but Musk facilitated much of the private industry groundwork for an electric revolution. Tesla produced battery technology ahead of its time, built incredible vehicles, and imagined a future where electric vehicles were not only capable but also desirable. Being a private corporation, the lack of a competitor allowed the company to flourish as a novel entity until it was ready to compete at a larger scale. While the economy was in regression during the release of Tesla Motors' first vehicles, it had an inverse relationship for their product. The tax credits created out of the auto industry's collapse in 2008 supported Tesla Motors' sales. Musk's leadership through Tesla Motors' iterative development cycle was critical. He created the loose roadmap of a vision while setting intermediate goals to aim for. His guidance shaped the products that Tesla Motors would release, ensuring they met an incredibly high standard. Coupled with his influence and reach, Musk enabled his company to retain a firm market footing over the last fifteen years. With Tesla's brand so closely tied to Musk, he has continued to develop technology to normalize electric vehicles.

¹⁷⁵ Robinson, "2012 Tesla Model S: Riding Shotgun."

¹⁷⁶ Robinson, "2012 Tesla Model S: Riding Shotgun."

¹⁷⁷ Musk, "The Secret Tesla Motors Master Plan."

Analysis

Both case studies illustrated successful organization change can occur if leadership can maintain a consistent vision and the resources to demonstrate the advantages of their advocated reform. During the interwar period, General George Marshall provided an image of the future force, which included massed armored vehicles. The looming war in Europe and emergency funding allowed him to overcome obstacles to change within his organization and create opportunities to show the efficacy of modern technology on the battlefield. Elon Musk's anchored his vision of a 'cooler' future, where electric vehicles provided the same performance of a sports car with the Model S but, his consistent messaging that it was possible enabled it to happen. Both leaders faced an audience that was generally unwilling to change, but their interim successes, Marshall's 1940 maneuvers, and Musk's Roadster allowed them to redefine the realm of the possible.

Marshall planned and resourced the transition from horses to motorized vehicles within the US Army, but the emergency funding provided to him in 1939 enabled him to execute the change within two years. Marshall clearly expressed his vision in his priorities and idea of how the force should fight, but his achievements are inexorably linked to funding. Marshall demonstrated his capability as a visionary leader by capitalizing on the moment. Immediately allotting funds to purchase new armored vehicles, then using them in a 400,000-man field exercise provided him the opportunity to influence organizational change and remove obstacles resistant to change. The critical concept to understand was that while progress towards motorization had occurred in the 1930s, it was not until the national emergency was declared that Marshall had the resources to act. Luckily, he was not decisive in his actions and committed to executing his vision, facilitating a rapid transition within the US Army.

Musk's circumstances were different, but no less dependent on the execution of his vision. Unlike Marshall, Musk could generate his funding through investors and vehicle orders.

Musk's message of a better future, where smog clouds didn't dominate the horizon, and the consumer did not need to compromise spread consistently to an ever-growing audience. Musk's cult of personality allowed him to tie his presence to the brand of Tesla Motors, and market his vision within his brand. When the Roadster was first released, it showed that there was a viable alternative to the combustion engine that could still be 'cool,' and validated the concept of his vision. The word of mouth Musk created allowed Tesla Motors vehicles to influence the underlying assumptions of the American public.

Despite the similarities in method, the motivations that drove change in the US Army and civilian corporations were distinctly different. As a result, there were some key ideas that the US Army could learn about organizational change from Tesla Motors. Conflict encouraged innovation, but the lessons learned from being involved in a dispute and viewing it from afar were different for the US Army and Tesla Motors. The US Army used conflict to justify changing, where Tesla Motors' leadership saw the collapse of competition as an incentive to begin. While the economic recession constrained the military, it did not stop technology from developing in the private sector. Regardless of the organization, a combination of leadership and demonstrated value were the best ways to remove obstacles to change. The case studies showed that there was value in preparing for the future, but the case studies also supported the conclusion that the best course of action may not necessarily be for change to happen immediately but to be shaped incrementally.

The need for change drove the US Army's transition from horse to motorized vehicles and the creation of Tesla Motors. The US Army began its transformation from a horse-borne military to a motorized one during World War One, but those efforts stagnated until the threat of World War Two became undeniable. For Tesla Motors, the abandonment by General Motors of electric vehicle development left a niche market to occupy with a minimal external threat. The underlying motivations for the military and private businesses seemed to run on inverse lines of logic. The US Army expected to engage in conflict and derived its motives from threats within

the environment. Tesla Motors seized on the need to fill a vacuum in the market. The lack of competitors created a secure environment for them to develop their vehicles, without the concern of disruption.

The case studies identified that military modernization efforts can take advantage of independent or partnered civilian technological advancement to speed their efforts. For the US Army in the 1930s, the Great Depression had crippled its development. At the same time, the civilian sector had continued to improve motor vehicles separate from the military purview. While the recession may have slowed the private industry's improvements on motor engines, it did not have the catastrophic effect that it did on the US Army's growth. The economic collapse of 2007 and 2008 supported Tesla Motors via tax credits and grants but forced the US Army to cut its budget aggressively. As Tesla Motors was operating in a non-competitive market, its position allowed them to capitalize on their competition's collapse. However, separate lines of effort between private businesses and the military can prevent the rapid integration of dual-use technology.

Since electric storage capacity and electric engine technology have not fully matured, there is a risk in both adopting the technology now and waiting to begin. Waiting may provide a more effective electric vehicle, but counting on a General Marshall to be ready to lead the organization rapidly may not be a reliable strategy. Neither of these stances negated the need for the US Army to switch to electric engines, only the timeline.

Both motorized and electric vehicles faced resistance from the established base of consumers and soldiers. While the arguments against them generally revolved around a fear of change, demonstrated benefits of new technology were the most significant counter to these arguments. The tanks and armored cars that General Marshall's forces rode to maneuvers between 1940 and 1941 were far more advanced than their outdated peers from 1918. Their protection and range rendered horses obsolete in a Western European environment. Similarly, when Tesla penetrated the luxury vehicle market with the Model S, it drew more comparisons to

Mercedes than a baseline Toyota.¹⁷⁸ The Model S showed the apparent capability of an electric vehicle to be a valid alternative to a combustion engine vehicle.

The case studies illustrated that the US Army needed a senior spokesperson that could announce their vision of a new army, and anchor it through multiple design iterations. Based on Marshall and Musk, leaders needed to root successes in soldiers' minds to build more significant change. Specific to the US Army, soldiers needed to trust the equipment that their lives may depend upon. Soldiers' natural resistance to change can only be overcome by the concerted effort and vision of a leader to show them how to defeat their enemies more effectively.

Organizational change in any group is difficult. Changing how an individual, let alone how a group thinks, is a significant challenge. The US Army must focus on the advantages of change and proactively seed the acceptance of electric vehicles into the force. Electrification is the near future transportation revolution facing the US military, but with the proper leadership and recognition of an adapting environment transitioning the organization should be not only possible but valuable.

¹⁷⁸ Faiz Siddiqui, "Ok Beemer: Why European Luxury Sedans Are Becoming a Relic of the Past and Electric SUVs Are on the Rise," *Washington Post*, December 5th, 2019.

Bibliography

- Allen, Christine; Khalil, Ghassan; Pozolo, Michael. "HEVEA Program Supports the Army's Need for Increased Power Demands." *Army Acquisition, Logistics & Technology Journal*, (January-March 2009): 50-53.
- Adelman, Clem. "Kurt Lewin and the Origins of Action Research." *Educational Research* 1, no. 1 (1993): 7-24.
- Assistant Secretary of Defense for Sustainment. "Fiscal Year 2020 Operational Energy Budget Certification Report." Government Printing Office, Washington, DC: May 17, 2017. Accessed March 22, 2020. <https://www.acq.osd.mil/eie/Downloads/OE/FY20%20Budget%20Certification%20Report.pdf>.
- Bennett, Andrew, and Alexander George. *Case Studies and Theory Development in the Social Sciences*. Cambridge, MA: MIT Press, 2005. Kindle.
- Berg, Phil. "9 Electric Cars You Can Actually Buy in 2012." *Popular Mechanics*, July 2, 2012. Accessed February 2, 2020. <https://www.popularmechanics.com/cars/hybrid-electric/g872/9-electric-cars-you-can-actually-buy-in-2012/>.
- Berger, Peter, and Thomas Luckman. *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*. 2nd ed. New York, NY: Anchor Books, 1989.
- Brown, Aaron. "Here's a Look Back at the Tesla Car That Started It All." *Business Insider*, March 30, 2016. Accessed January 9, 2020. <https://www.businessinsider.com/tesla-roadster-history-2016-3>.
- Carrico, Jason A. "Mitigating the Need for a Logistic Pause." Masters Monograph, School of Advanced Military Studies, US Army Command and General Staff College, Ft. Leavenworth, Kansas, 2006.
- Christensen, Clayton. "Disruptive Innovation." *Christensen Institute*, 2019. Accessed December 22, 2019. <https://www.christenseninstitute.org/disruptive-innovations/>.
- Coffman, Makena, Paul Bernstein, and Sherilyn Wee. "Factors Affecting Ev Adoption: A Literature Review and EV Forecast for Hawaii." University of Central Florida, Cocoa, FL, April 2015.
- Coffman, Makena, Scott F. Allen, and Sherilyn Wee. "Who Are Driving Electric Vehicles? An Analysis of Factors That Affect EV Adoption in Hawaii." The Economic Research Organization at the University of Hawaii, Honolulu, HI, May 2018.
- Cunningham, John S. *An Analysis of Battery Electric Vehicle Production Projections*. Cambridge, MA: Massachusetts Institute of Technology, 2009.
- Daley, John. "Patton Versus the "Motor Maniacs": An Inter-war Defense of Horse Cavalry." *Armor Journal* 106, no. 2 (March-April 1997): 12-15.

- Danneels, Erwin. "Disruptive Technology Reconsidered: A Critique and Research Agenda." *Journal of Product Innovation and Management* 7, no. 2 (2004): 246-58.
- Davies, Alex. "Meet the Cybertruck, Tesla's Ford-Fighting Pickup." *Wired*, November 21, 2019. Accessed February 1, 2020. <https://www.wired.com/story/electric-tesla-pickup-truck-announcement-specs-cost-photos/>.
- Davis, Paul K; Gompert, David C; Hillestad, Richard J; and Johnson, Stuart. "Transforming the Force: Suggestions for DoD Strategy." National Defense Research Institute, Washington, DC, 1998. Accessed November 5, 2019. https://www.rand.org/pubs/issue_papers/IP179/index2.html.
- Foss, Murray. "Changing Patterns of Fuel Consumption." *Survey of Current Business, US Department of Commerce* (July 1948): 7-11.
- Gould, Joe. "All-Electric Brigades? US Army Officials say it's Coming Sooner Than You'd Think." *Defense News*, October 11, 2017. Accessed September 10, 2019. <https://www.defensenews.com/digital-show-dailies/ausa/2017/10/11/all-electric-brigades-us-army-official-says-its-coming-sooner-than-you-d-think/>.
- Gluckman, David. "2011 Nissan Leaf SL." *Car and Driver*, August 25, 2011. Accessed February 10, 2020. <https://www.caranddriver.com/reviews/a15124059/2011-nissan-leaf-sl-long-term-road-test-review/>.
- Hagan, Kenneth J., and Roberts, William R. *Against All Enemies: Interpretations of American Military History from Colonial Times to the Present*. Westport, CT: Greenwood Publishing Group, 1986.
- Hardman, Scott, Robert Steinberger-Wilckens, and Dan van der Horst. "Disruptive Innovations: The Case for Hydrogen Fuel Cells and Battery Electric Vehicles." *International Journal of Hydrogen Energy* 38, no. 52 (November 2013): 15438-51.
- Higgins, Tim. "Akerson Demands GM Innovation to Blunt Tesla Threat." *Bloomberg*, July 17, 2013. Accessed December 15, 2019. <https://www.bloomberg.com/news/articles/2013-07-18/akerson-demands-gm-innovation-to-guard-against-musk-effect-cars>.
- Holmberg, Arita, and Aida Alvinus. "How Pressure for Change Challenge Military Organizational Characteristics." *Journal of Military and Strategic Studies* 19, no. 2 (2019): 130-48.
- Hoffmann, George F. "The Demise of the U.S. Tank Corps and Medium Tank Development Program." *Military Affairs* 37, no. 1 (February 1973): 20-25.
- Hundly, Richard O. *Past Revolutions and Future Transformations: What Can History of Revolutions in Military Affairs Tell Us About Transforming the U.S. Military?*. Washington, DC: National Defense Research Institute, 1999.
- "Interview: Rick Wagoner, General Motors CO." *Motortrend*, 2006. Accessed December 15, 2019. <https://www.motortrend.com/news/rick-wagoner-general-motors/>.
- IW Staff. "Next Gen Batteries to Power up Electric Vehicle Installed Base to 100 Million by

- 2028.” *Industry Week*, August 9, 2019. Accessed December 15, 2019. <https://www.washingtonpost.com/technology/2019/12/05/ok-beemer-why-european-luxury-sedans-are-becoming-relic-past-electric-suvs-are-rise/>.
- Kane, Gerald, and John Gallaugher. “The Silicon Valley Caravan: What Sets the Tech Upstarts Apart?” *MIT Sloan Management Review*, June 6, 2017. Accessed November 13, 2019. <https://sloanreview.mit.edu/article/the-silicon-valley-caravan-what-sets-the-tech-upstarts-apart/>.
- Kelly, Christopher. “Book Note Culture and Competition in Silicon Valley and Route 128: Regional Advantage.” *Harvard Journal of Law and Technology* 8, no. 2 (1995): 521-28.
- Kolodny, Lora and Michael Wayland. “Tesla Cybertruck Tug-of-war with a Ford F-150 Is High Stakes and Highly Unlikely.” *CNBC*, November 26, 2019. Accessed February 2, 2020. <https://www.cnbc.com/2019/11/26/tesla-cybertruck-tug-of-war-with-a-ford-f-150-is-high-stakes-unlikely.html>.
- Knox, MacGregor, and Williamson Murray. *The Dynamics of Military Revolution, 1300–2050*. Cambridge University Press: Cambridge, UK, 2001.
- Kotter, John P. *Leading Change*. Boston, MA: Harvard Business School Press, 1996.
- Johnson, David E. “From Frontier Constabulary To Modern Army” in *The Challenges of Change: Military Institutions and New Realities 1918-1941*, edited by Harrold Winton and David Mets, 162-220. Omaha, NE: University of Nebraska Press (May, 2003).
- Johnston, Paul. “Doctrine Is Not Enough: The Effect of Doctrine on the Behavior of Armies.” *Parameters* (Autumn 2000): 30-39.
- Locke, Edwin. “The Ideas of Frederick w. Taylor: An Evaluation.” *Academy of Management Review* 7, no. 1 (1982): 14-24.
- Lundy, Mike. “Large Scale Ground Combat Operations Study.” Presented to SAMS, Fort Leavenworth, KS, June 18, 2019.
- Mangram, Myles. “The Globalization of Tesla Motors: A Strategic Marketing Plan Analysis.” *Journal of Strategic Marketing* 20, no. 4 (July 2012): 289-312.
- Martin, Blake, Caroline Clothiaux, and Peter Lund. “Driving Off a Cliff: The Case Against Tesla.” College Thesis, Auburn University, Auburn, AL, 2015.
- McFadden, Christopher. “The Short but Fascinating History of Tesla.” *Interesting Engineering*, October 26, 2019. Accessed December 9, 2019. <https://interestingengineering.com/the-short-but-fascinating-history-of-tesla>.
- McGrath, John J. *Scouts Out! The Development of Reconnaissance Units in Modern Armies*. Fort Leavenworth, KS: Combat Studies Institute Press, 2008.
- Melton, Anna. “What Can We Learn from Tesla's \$0 Marketing Strategy?” *Data Marketing Association*, January 24, 2018. Accessed November 16, 2019. <https://dma.org.uk/article/what-can-we-learn-from-teslas-0-marketing-strategy>.

- Millet, Allen R., and Williamson Murray. *Military Effectiveness, Volume 2: The Interwar Period*. 2nd ed. New York, NY: Cambridge University Press, 2010.
- Meyer, Robinson. "A Big Silly Cybertruck," *Atlantic*, November 23, 2019. Accessed March 2, 2020. <https://www.theatlantic.com/technology/archive/2019/11/whats-good-about-elon-cybertruck/602524/>.
- Musk, Elon. "Few people know that we started Tesla when GM forcibly recalled all electric cars from customers in 2003 and then crushed them in a junkyard." Twitter, June 9, 2017. Accessed March 3, 2020. <https://twitter.com/elonmusk/status/873116351316938753>.
- Musk, Elon. "The Secret Tesla Motors Master Plan (Just between You and Me)." *Tesla* (blog), August 6, 2006. Accessed March 3, 2020. <https://www.tesla.com/blog/secret-tesla-motors-master-plan-just-between-you-and-me>.
- Nielsen, Suzanne. "An Army Transformed: The S.S. Army's Post-Vietnam Recovery and the Dynamics of Change in Military Organizations." US Army War College, Carlisle, PA, 2010.
- Norwich University Online. "Isolationism and U.S. Foreign Policy After World War I." *Norwich University*, November 6, 2017. Accessed December 17, 2019. <https://online.norwich.edu/academic-programs/resources/isolationism-and-us-foreign-policy-after-world-war-i>.
- Page, Lewis. "Elon Musk Hits Out at Co-Founder's Tesla Roadster Allegations." *The Register*, June 23, 2009. https://www.theregister.co.uk/2009/06/23/musk_broadside_eberhard/.
- Porter, Michael. "The Five Forces." *Harvard Business School Institute for Strategy and Competitiveness*, 2019. Accessed October 28, 2019. <https://www.isc.hbs.edu/strategy/business-strategy/Pages/the-five-forces.aspx>.
- Ricks, Thomas. "Lose a General, Win a War." *New York Times*, June 24, 2010.
- Rosen, Stephen Peter. *Winning the Next War*. Ithaca, NY: Cornell University Press, 1991.
- Rutter, Tamara. "Why Tesla Has the Most Loyal Customers." *USA Today: The Motley Fool*, September 6, 2014. Accessed December 8, 2019. <https://www.usatoday.com/story/money/cars/2014/09/06/why-tesla-has-the-most-loyal-customers/15139377/>.
- Schumpeter, Joseph. *Capitalism Socialism and Democracy*. New York, NY: George Allen & Unwin Ltd, 1994.
- Scott, Hardman, Eric Shiu, and Robert Steinberger-Wilkens. "Changing the Fate of Fuel Cell Vehicles: Can Lessons Be Learnt from Tesla Motors?" *International Journal of Hydrogen Energy* 40 (2015): 1625-38.
- Siddiqui, Faiz. "Ok Beemer: Why European Luxury Sedans Are Becoming a Relic of the Past and Electric SUVs Are On the Rise." *Washington Post*, December 5, 2019. Accessed March 3, 2020. <https://www.washingtonpost.com/technology/2019/12/05/ok-beemer-why->

europaen-luxury-sedans-are-becoming-relic-past-electric-suvs-are-rise/.

Sorokanich, Bob. "Elon Musk Admits to Shareholders That the Tesla Roadster Was a Disaster." *Road and Track*, June 1, 2016. Accessed December 15, 2019.

<https://www.roadandtrack.com/new-cars/news/a29378/elon-musk-admits-to-shareholders-that-the-tesla-roadster-was-a-disaster/>.

Staley, Oliver. "The General Motors CEO Who Killed the Original Electric Car Is Now in the Electric Car Business." *Quartz*, April 7, 2017. Accessed December 13, 2019.

<https://qz.com/952951/the-general-motors-gm-ceo-who-killed-the-ev1-electric-car-rick-wagoner-is-now-in-the-electric-car-business/>.

Steele, Brett. "Military Reengineering Between the World Wars." Corporate Monograph, National Defense Research Institute, Santa Monica, CA, 2005.

Stephenson, Harris. "Mission Command-Able? Assessing Organizational Change and Military Culture Compatibility in the US Army." *Journal of Military and Strategic Studies* 17, no. 1 (2016): 104-43.

Strachan, Hew. *The Direction of War*. 4th ed. Cambridge, UK: Cambridge University Press, 2014.

Stringham, Edward, Jennifer Miller, and J.R. Clark. "Overcoming Barriers to Entry in an Established Industry: Tesla Motors." *California Management Review* 57, no. 4 (Summer 2015): 85-103.

"Tesla Roadster Production Will End Next Year." *US News and World Report*, February 1, 2010. February 17, 2020. <https://cars.usnews.com/cars-trucks/daily-news/100201-tesla-roadster-production-will-end-next-year>.

Turchetta, Diane. "The Car of the Future, Today." *US Department of Transportation: Federal Highway Administration Research and Technology* 76, no. 3 (November/ December 2012).

US Army. Army US Field Manual 3-0, *Operations*. Washington, DC: Government Printing Office, 2017.

US Army. Field Manual 6-22, *Army Leadership: Competent, Confident and Agile*. Washington DC: Government Printing Office, 12 October 2006.

US Department of Defense. Joint Publication 3-0: *Joint Operations*. Washington, DC: Government Printing Office, January 17, 2017.

Vanderwerp, Dave. "2011 Chevrolet Volt Full Test." *Car and Driver*, December 2010. Accessed December 15, 2019. <https://www.caranddriver.com/reviews/a15128758/2011-chevrolet-volt-test-review/>.

"Vital Intangibles." *The Economist; London* 342, no. 10 (March 29, 1997): 7-12.

Watson, Mark S. *Chief of Staff: Prewar Plans and Preparations*. Washington, DC: Department of the Army, Historical Division, 1950.

Woudhuysen, James. "The Electric Car Conspiracy... That Never Was." *Register*, January 1, 2008. Accessed March 31, 2020.
https://www.theregister.co.uk/2008/01/01/woudhuysen_electric_car/.