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ANTICIPATORY INTELLIGENCE RESILIENCE MODELING EVALUATION OF ASPIRE RESEARCH CENTER

by

Madeleine Alder

**Capstone submitted in partial fulfillment
of the requirements for graduation with**

University Honors

with a major in
International Studies and Economics

in the Department of Political Science and Economics

Approved:

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Abstract

The analysis of threats and vulnerabilities in a system is essential in developing resilience strategies to strengthen the system's ability to adapt and succeed. This report delivers a threat analysis of ASPIRE, a research organization centered on engineering solutions for promoting electric vehicle (EV) adoption. ASPIRE, which is an international network of university research partners and comprised primarily of engineering teams, is focused on developing technology that can be used by industry or governmental partners. The threat of low public buy-in for ASPIRE technology is one of the most significant concerns facing the system. Low adoption rates or public resistance against the company could lessen ASPIRE's operational success and funding potential.

The ASPIRE system has strengths that improve its resilience, as well as vulnerabilities that put the system at greater risk of failing because of this threat. Existing community partnerships strengthen ASPIRE's resistance to the threat of low public buy-in, but the company could benefit by increasing outreach to key stakeholders. The enthusiasm of ASPIRE employees about the company's mission helps the company succeed in the face of risks. Additionally, ASPIRE's varied research focuses allow it to retain its core purpose if one project fails. However, ASPIRE's ability for threat recovery is potentially lowered because of reliance on public funding; proving worth to funders is challenging if ASPIRE projects fail to achieve public support.

The conclusion of this threat analysis is a set of recommendations to improve the system's resilience potential. These recommendations include the implementation of training and project reporting so that every ASPIRE engineer includes an evaluation of public buy-in potential in their research process. Another recommendation is to increase marketing efforts to improve external perceptions of ASPIRE and address key concerns like product safety and usefulness. The final suggestion is to increase partnerships with industry members and community stakeholders. This builds ASPIRE's recovery potential by positioning the organization in an advantageous place for future funding.

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I am also grateful for the support of Briana Bowen, another teacher and mentor who helped me with this project. I have been lucky to take several classes from Ms. Bowen and I am always impressed by the passion and dedication she brings to her work, whether it is providing in-depth feedback on a draft or listening attentively to questions during office hours. She helped me work through several drafts of this project and offered a helpful set of eyes as I worked through tricky questions in my research. Ms. Bowen is an inspiring example in both her academic excellence and her personal kindness. I loved being able to learn from her as she helped me find ways to think creatively about my research.

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Overview

A system can be made stronger by building awareness of its vulnerabilities, identifying potential threats, and implementing strategies to strengthen weak points. I conducted a threat analysis of ASPIRE, an international electric vehicle research organization based at Utah State University. In my evaluation, the most prominent threat facing the ASPIRE system is a potential for low public buy-in to their technology. The ASPIRE system has several strengths, including a company culture that is enthusiastic about adaptability and a variety of research focus areas that provide flexibility in the face of this specific threat. The system also has potential for growth, including the expansion of community outreach, industry partnerships, and public visibility. Strengthening the system in these ways increases ASPIRE's ability to be resilient against the threat of low public buy-in.

Evaluating the resilience of this system required a thorough assessment across several aspects of ASPIRE's operations. Using a framework developed within the Center for Anticipatory Intelligence program, I mapped the ASPIRE system, assessed potential threats and vulnerabilities, and created recommendations for resilience. In the threat evaluation process, I first established an understanding of the system, including essential human and material nodes, connecting pieces, and boundaries. Next, I evaluated potential threats that could impact the system, and mapped these by their impact and likelihood. Then, I narrowed in on one threat and assessed the system's current ability to face that threat. This assessment focuses on four primary areas of resilience: resistance, retention, recovery, and resurgence. Finally, I synthesized my findings to create a series of recommendations that will improve the system's resilience.

Establishing an Understanding of the ASPIRE System

The overarching goal of ASPIRE is to achieve sustainable energy solution, with a specific focus on improving health and quality of life through green energy innovation.¹ The organization is made of a web of moving parts, categorized as nodes and edges of an intricate system. ASPIRE is a network of university research partners stretching across the globe, including Utah State University, Purdue University, University of Colorado Boulder, University of Texas El Paso, and the University of Auckland New Zealand.²

Each of these universities resembles a node in the system and the people working within each research institution represent smaller nodes. Each university has people concentrating on different parts of ASPIRE's operations.³ Their roles include specialists in engineering, workforce development, market intelligence, policy analysis, and social equity.⁴ Additionally, the ASPIRE organization relies on structural support from people in leadership and administrative roles.

While people make up important nodes in the ASPIRE system, they are also connected to other nodes in the system such as physical or digital pieces of the puzzle. ASPIRE focuses on

¹ ASPIRE. n.d. "Advancing Sustainability through Powered Infrastructure for Roadway Electrification," Accessed 21 January 2022. <https://aspire.usu.edu/>

² Ibid.

³ Cortez, Marjorie. 2021. "Will Utah Become Epicenter of Research to Electrify Transportation?" *Deseret News*, 13 January.

⁴ ASPIRE. n.d. "Center Leadership," Accessed 21 January 2022. <https://aspire.usu.edu/people/center-leadership/index>

electric transport innovation, so there are many connected pieces of technology, including electric cars and trucks, roads and highways, charging pads, and batteries. Elements of software are also important and ASPIRE has an entire research team dedicated to the data side of their operations.⁵ Computers, software programs, computer chips, and data sharing services are all vital pieces of ASPIRE's system.

All nodes in ASPIRE's operations—people, vehicles, infrastructure, batteries, software, and more—are connected through relationships, or the “edges” of the system. Since ASPIRE is an international organization working to coordinate research across multiple universities on two continents, an essential part of the company's process is facilitating secure, reliable, and effective communications between their various research teams.⁶ Additionally, in the testing and production phases of ASPIRE's technology development, coordination between producers and sellers of materials are vital. Especially considering recent complications to supply chains due to the coronavirus pandemic and other factors, the connections between materials and people have become more central to ASPIRE's functions.⁷

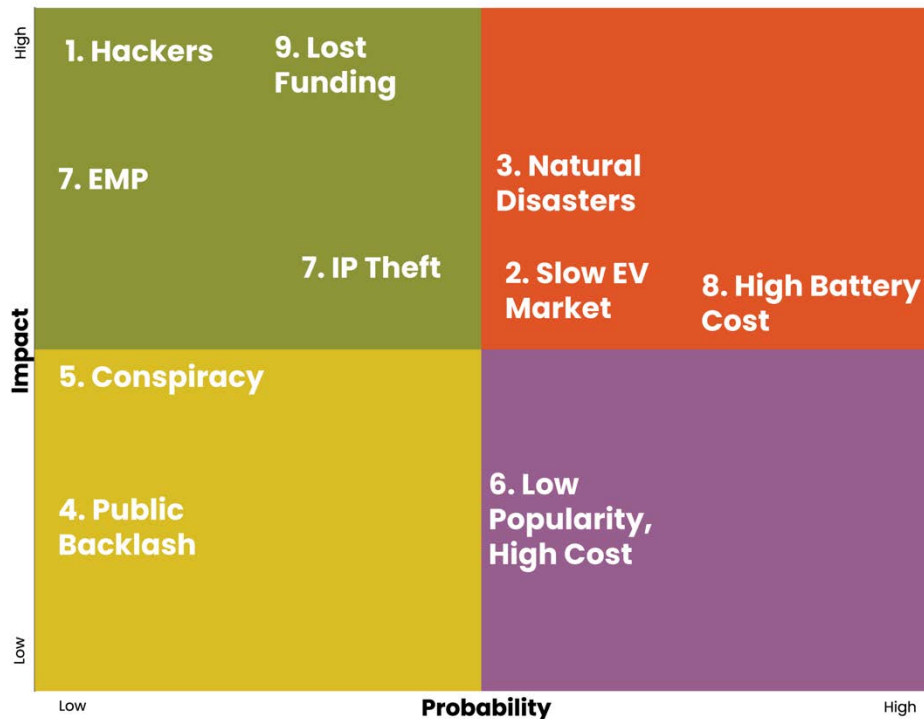
⁵ ASPIRE. n.d. “Research Thrusts,” Accessed 21 January 2022. <https://aspire.usu.edu/research/thrusts/index>

⁶ Ibid.

⁷ Harrison, Daniel, and Christopher Ludwig. 3 June 2021. “Electric Vehicle Battery Supply Chain Analysis 2021: How Lithium-ion Battery Demand and Production are Reshaping the Automotive Industry,” Accessed 21 January 2022. <https://www.automotive-logistics.media/electric-vehicles/electric-vehicle-battery-supply-chain-analysis-2021-how-lithium-ion-battery-demand-and-production-are-reshaping-the-automotive-industry/41924.article>

Threat Mapping

It is important to evaluate a broad range of potential threats in order to eventually narrow in on the most important threat against a system. This strategy helps steer away from a “failure of imagination” scenario, a case in which some viable threats are not considered because they fall outside the scope of ordinary expectations. Considering a range of threats allows for a better understanding of the systems vulnerabilities. Then mapping all threats in in terms of high or low impact and probability helps direct the focus of future threat preparation.



Threat 1: Hackers Creating Chaos by Targeting Transportation Infrastructure May Take Aim at ASPIRE

Hackers intending to damage US systems or create chaos could target ASPIRE in hopes of bringing down transportation infrastructure.⁸ This is a relatively low probability threat because ASPIRE is not yet a significant source of public energy utilities, and disruption of its services would not have a massive public impact. However, if this threat did occur, the impact would be high because hackers could potentially wipe out large amounts of data or break key parts of ASPIRE software.⁹ Due to ASPIRE’s status as a new company, it could be seen as an easy target or a weak link in the chain of public utilities and transportation.¹⁰ Electric vehicle charging infrastructure could be a vulnerable target for hackers because successful destabilization of EV charging could leave many people without means of transportation.¹¹ Author Andrea Vittorio explains, “In the rush to set up EV charging infrastructure, some manufacturers haven’t thought

⁸ Kshetri, Nir, and Jeffrey Voas. "Hacking power grids: A current problem." *Computer* 50, no. 12 (2017): 91-95.

⁹ Cashell, Brian, William D. Jackson, Mark Jickling, and Baird Webel. "The economic impact of cyber-attacks." *Congressional research service documents, CRS RL32331 (Washington DC) 2* (2004).

¹⁰ Kok Wei Ooi, , Seung-Hyun Kim, Qiu-Hong Wang, and Kai Lung Hui. "Do hackers seek variety? an empirical analysis of website defacements." AIS, 2012.

¹¹ Andrea Vittorio, “Electric Vehicle Infrastructure Push Brings Cyber Concerns,” *Bloomberg Law*, 24 August 2021

enough about security.”¹² This suggests that companies like ASPIRE who are under pressure to develop products quickly in hopes of tackling climate change mitigation should prepare for the risk of cyber security breaches.

Threat 2: Slow Growth of EV Market Undermines Practicality of Widespread Wireless Charging Infrastructure.

ASPIRE’s success as a tool for widespread public use is dependent on a wide share of the population using electric vehicles, so the company’s survival may be threatened by a low level of overall adoption of EVs. This is a high probability threat because trends in EV buying in the US have been slow.¹³ Although electric vehicles have been the subject of much media attention and legislative consideration, electric cars hold a relatively small market share within the US.¹⁴ Only 7% of US adults have an electric or hybrid vehicle, and electric cars account for only 2% of the vehicle market.¹⁵ The growth projected in electric vehicles in the US is significantly slower than other countries, especially China, the country experiencing fastest growth in EV adoption.¹⁶ The relatively slow rates of growth in EV adoption in the US cause doubt that the US will reach a high enough density of EV ownership in time to make ASPIRE’s work worthwhile.

Threat 3: ASPIRE Infrastructure at Risk of Damage From Natural Disasters, Variable Weather Events

ASPIRE’s roadway wireless charging infrastructure is naturally subject to a wide array of physical threats, which is a growing concern due to unpredictable weather patterns caused by climate change.¹⁷ Since ASPIRE’s roadways will be exposed to weather year-round, they are at risk of severe damage by natural disaster, as well as persistent damage from the daily weathering that roads experience.¹⁸ The threat of damage by weather events grows more serious each year because of the increasingly drastic storms, droughts, and floods that are a consequence of a changing climate.¹⁹ Recently, modeling technology simulated the result of a hurricane hitting a city where everyone had electric vehicles.²⁰ The model showed that two-thirds of the power authorities would likely lose power, which would then cause a chain of consequences. ASPIRE could be at risk of similar results during storms, hurricanes, or floods; this high impact threat would endanger the people who rely on ASPIRE to charge their vehicles, and the company would be at a risk of large financial losses.

Threat 4: Lack of Consideration for Socially Equitable Implementation of Technology Brings Public Backlash.

¹² Ibid.

¹³ Drew Desilver, “Today’s Electric Vehicle Market: Slow growth in the U.S., faster in China, Europe,” Pew Research Center, 7 June 2021.

¹⁴ Djamel Rahmani and Maria L. Loureiro. "Why is the market for hybrid electric vehicles (HEVs) moving slowly?." *PloS one* 13, no. 3 (2018): e0193777.

¹⁵ Drew Desilver, “Today’s Electric Vehicle Market: Slow growth in the U.S., faster in China, Europe,” Pew Research Center, 7 June 2021.

Alex Kopestinsky, “Electric Car Statistics in the US and Abroad,” Policy Advice, 12 August 2021.

¹⁶ Drew Desilver, “Today’s Electric Vehicle Market: Slow growth in the U.S., faster in China, Europe,” *Pew Research Center*, 7 June 2021.

¹⁷ N.A. “The Effects of Climate Change,” *NASA Global Climate Change*, Accessed 27 January 2022. <https://climate.nasa.gov/effects/>

¹⁸ Farid Kadri, Babiga Birregah, and Eric Châtelet. "The impact of natural disasters on critical infrastructures: A domino effect-based study." *Journal of Homeland Security and Emergency Management* 11, no. 2 (2014): 217-241.

¹⁹ Raktima Dey, and Sophie C. Lewis. "Natural disasters linked to climate change." In *The Impacts of Climate Change*, pp. 177-193. Elsevier, 2021.

²⁰ Kairui Feng, Ning Lin, Siyuan Xian, Mikail V. Chester, “Can We Evacuate From Hurricanes with Electric Vehicles?” *Science Direct*, 15 July 2020.

ASPIRE's wireless charging technology is currently more accessible to wealthier groups of people who can afford to buy electric vehicles.²¹ Without thoughtful consideration and implementation of plans to reach out to populations across the wealth spectrum, ASPIRE could be the target of public backlash for the lack of equitable access to its technology. This backlash could potentially grow to include violence, protests, or a negative social image, all of which could become fatal for ASPIRE's success. The EV market is much less accessible to dense urban areas and lower income households,²² which means that ASPIRE's target market of EV owners is a small, wealthy swath of the population. However, because it is an institution that receives government funding, the company could come under public scrutiny for a failure to allocate its product equitably across the spectrum of wealth. However, this is a low probability threat, unless public groups were very well organized, they may not be able to threaten ASPIRE in a serious way.

Threat 5: Anti-EV Conspiracy, Combined with Public Distrust of ASPIRE Could Bring Hostility

ASPIRE is reliant on government funding and public support, which gives taxpayers a higher sense of ownership in the company's actions, especially if groups are unified by anti-EV conspiracy theories.²³ This could become a liability if members of the public disagree with ASPIRE's projects and act in hostility toward the company. Protestors motivated by conspiracy theories about electric vehicles could lash out against ASPIRE.²⁴ Conspiracy theories about electric vehicles are already a present concern; for example, Anti-Tesla conspiracy theories have led some people to harass Tesla owners and shareowners.²⁵ The threat of conspiracies being directed at ASPIRE is fairly low probability because anti-EV conspiracy theories have not developed to a hugely powerful level yet, but if this were to occur then the impact would not likely be enough to completely ruin ASPIRE, they could still likely bounce back from the threat. It should be noted that the most potent conspiracy theories are politically motivated, a concept that could be leveraged against ASPIRE and other EV manufacturers because electric vehicles have historically been supported by the Biden administration.²⁶

Threat 6: ASPIRE Technology Follows Trajectory of Nuclear Power: High cost, High Public Concern.

The electric vehicle (EV) charging technology being developed by ASPIRE has not been fully released to the public, so it is still uncertain whether the product will be perceived positively by consumers. Since ASPIRE's technology is new and unfamiliar, it is possible that it could be received poorly by the public, which is a scenario with an average level of likelihood because EV adoption has so far been somewhat low but seems to have high potential, based on current investment and government support.²⁷ The success of ASPIRE could be threatened by

²¹ Scott Witchalls and Johnathan Riggall, "How Can We Tackle the Social and Economic Inequality in the UK When It Comes to the Cost of Charging an Electric Vehicle?" *Stantec*, 15 March 2018.

²² Bauer, Gordon, Chih-Wei Hsu, and Nic Lutsey. "When might lower-income drivers benefit from electric vehicles? Quantifying the economic equity implications of electric vehicle adoption." *Work. Pap* 6 (2021).

²³ Joseph E. Uscinski and Joseph M. Parent. *American conspiracy theories*. Oxford University Press, 2014.

²⁴ Jessica Wolf, "How Conspiracy Theories Emerge – and How Their Storylines Fall Apart," *UCLA Newsroom*, 25 June 2020.

²⁵ Johnna Crider, "Amplifying Anti-Tesla Conspiracy Theorists Isn't A Good Look For Consumer Reports," *CleanTechnica*, 1 October 2021.

²⁶ The White House, "FACT SHEET: The Biden-Harris Electric Vehicle Charging Action Plan," *The White House Briefing Room*, 13 December 2021. <https://www.whitehouse.gov/briefing-room/statements-releases/2021/12/13/fact-sheet-the-biden-harris-electric-vehicle-charging-action-plan/>

²⁷ The White House, "FACT SHEET: The Biden-Harris Electric Vehicle Charging Action Plan," *The White House Briefing Room*, 13 December 2021. <https://www.whitehouse.gov/briefing-room/statements-releases/2021/12/13/fact-sheet-the-biden-harris-electric-vehicle-charging-action-plan/>

similar factors that proved to be the downfalls in the popularity of nuclear energy technology. Nuclear technology was once considered a promising solution for replacing oil and gas-powered energy, but demand for nuclear energy has fallen significantly.²⁸ In the 1970s there was a boost in nuclear energy's popularity during nationwide oil crises. After nuclear meltdowns like Chernobyl and Three Mile Island, safety concerns began to tarnish the public perception of nuclear, which eventually hit its peak of supplying 17.6 percent of the world's electricity in 1996.²⁹ While nuclear power facilities are still being built, their popularity has decreased and high production costs make it a less viable option. ASPIRE could follow a similar trajectory if its technology is publicly perceived as unsafe or if there was a large accident involving ASPIRE that had negative impacts on public health. However, because ASPIRE's technology has proved safe so far and lacks some of the more dangerous qualities of nuclear technology, it is likely that ASPIRE would not be heavily impacted by this threat and could bounce back reasonably well if the company ever met a problem like this.

Threat 7: Information Theft Could Compromise ASPIRE Technology and Boost Hostile Competition

ASPIRE technology is innovative and remains unique within the sphere of electric vehicle development,³⁰ but the company is not without competitors who could be motivated to steal ASPIRE's technology. The company could suffer from Intellectual Property (IP) theft at the hands of industry competitors in the US or other countries.³¹ The risk is currently a medium range probability because ASPIRE is such a recent entrant to the market, but it is a growing threat as ASPIRE becomes more popular.³² If the company were to experience IP theft, impact could be severe because ASPIRE would lose its competitive edge. The field of electric vehicles is a competitive space where fast growth and innovation are highly valued, so the original research coming out of ASPIRE could be a tantalizing prize to steal away and sell to private investors. There are other groups that are experimenting with similar technology to ASPIRE's work so there would be some rewards in taking information from ASPIRE and selling it to other groups.³³

Threat 8: Rising Costs of Batteries, Shortages in Materials May Make EVs Less Viable

Recent spikes in battery costs present threats to car makers who are betting on the success of electric vehicles, which could threaten the long-term viability of electric vehicles and the need for the product offered by ASPIRE.³⁴ The likelihood of this scenario is rising quickly as increasing battery prices reverse the trend that had ruled much of the past decade, the market had seen a 90% drop in cost since 2010.³⁵ If the rise in battery costs continues, it could have significant impacts on the EV market and potentially stunt growth of EV popularity. Shortages in battery materials are a rising concern, especially considering the high volume of material that

Ari Levy, "EV Stocks Soared on Hype in 2021 – Investors re Betting 2022 ill Bring Actual Revenue," *CNBC*, 26 December 2021.

²⁸ Peter Fairley, "Why Don't We Have More Nuclear Power?" *MIT Technology Review*, 28 May 2015.

²⁹ Ibid.

³⁰ Kerry Hannon, "Could Roads Recharge Electric Cars? The Technology May Be Close," *New York Times*, 29 November 2021.

³¹ N.A., "Intellectual Property Theft and Piracy," *Federal Bureau of Investigation*, Accessed 26 January 2022. <https://www.fbi.gov/investigate/white-collar-crime/piracy-ip-theft>

³² N.A., "Why the EV Industry is a Breeding Ground for Trade Secret Theft," *Wit Legal*, 7 October 2021.

³³ Mia Yamauchi, "Mainstream Electric Car Makers Race to Wireless EV Charging," *Plugless Power*, 2021.

³⁴ Todd Gillespie, "Rising Battery Costs Hit Carmakers, Threaten Climate-Change Push," *Bloomberg*, 30 November 2021.

³⁵ Steve LeVine, "What GM, Ford and VW Need to Do to Avoid Selling EVs At a Loss," *The Electric*, 23 January 2022.

would be needed if EVs ever grow to replace gasoline-powered vehicles.³⁶ The viability of having wide scale adoption of electric vehicles may not be possible given current and projected shortages, which in turn could decrease ASPIRE's value and hurt their prospects to get funding.

Threat 9: Variability in Funding Could Endanger ASPIRE's Lasting Success

ASPIRE is a company centered in universities and is reliant on grants for its funding, losing that funding is a low probability threat because ASPIRE has been successful in securing funding in the past and continues to develop its research in a promising way, but lost funding would be devastating to the company. One year ago, the National Science Foundation (NSF) awarded Utah State University a \$26 million grant over five years to be used for the foundation of ASPIRE.³⁷ While the NSF grant marked an important step for ASPIRE's success, it also captures the variability that could plague ASPIRE depending on future events. In five years, ASPIRE will need to apply for new funding, whether from the NSF or another source. Forces outside of ASPIRE's control could impact whether the company is funded again, including the value of electric vehicles in the market at that time, success of other competitors in the wireless charging field, how NSF has allocated the rest of its funds, or whether ASPIRE falls into the priorities of NSF's funding range at that time. Additionally, ASPIRE could be at risk of betraying its original mission or altering its priorities in a negative way in order to receive funding if it cannot secure stable funding from the NSF.³⁸ The likelihood of ASPIRE failing to renew its NSF grant is low, given that the agency now has proposed budget increases, but it is still possible that NSF directs funding away from ASPIRE because of other priorities.³⁹

Threat 10: Electromagnetic Pulse Could Cause Short-term Electric Shortages and Long-term Technological Damage

An electromagnetic pulse (EMP) could knock out electric power and disable ASPIRE technology for a significant time, as well as potentially breaking ASPIRE infrastructure completely.⁴⁰ An EMP is a short burst of electromagnetic energy that disrupts electricity, something that can occur naturally, like in a solar storm or lightning strike, or can be produced artificially with EMP weapons.⁴¹ The threat of an EMP occurrence remains rare, but it is a risk that companies and governments still prepare seriously for, like recent action taken by the Air Force to guard a base in Texas against an EMP attack.⁴² Although the threat is low, the impact on ASPIRE could be large. All companies and people who use any function of the electric grid are impacted by an EMP occurrence, but the risk is even larger for a company like ASPIRE that is reliant on power for its core function of charging vehicles. While electromagnetic pulse would put ASPIRE infrastructure out of commission during the time that electricity is impacted by the pulse, there is an even larger risk that the pulse overwhelms and completely breaks the infrastructure.⁴³

³⁶ Neil Winton, "Battery Scarcity Could Dwarf Chip Shortage Impact On Global Auto Sales," *Forbes*, 27 July 2021.

³⁷ N.A. "USU Launches NSF-funded Engineering Research Center for Electrified Transportation," *Utah State TODAY*, 4 August 2020.

³⁸ Gordon Gallup and Bruce Svare, "Hijacked by an External Funding Mentality," *Inside Higher Ed*, 25 July 2016.

³⁹ Ariana Remmel, "How a Historic Funding Boom Might Transform the US National Science Foundation," *Nature*, 23 April 2021.

⁴⁰ "Electromagnetic Pulse (EMP) Program Status Report" *U.S. Department of Homeland Security*, 17 August 2020.

⁴¹ Office of Radiation Protection, "Electromagnetic Pulse (EMP)," *Washington State Department of Health*, September 2003.

⁴² Edd Gent, "US Air Force is Guarding Against Electromagnetic Pulse Attacks. Should We Worry?" *Live Science*, 11 March 2021.

⁴³ Office of Radiation Protection, "Electromagnetic Pulse (EMP)," *Washington State Department of Health*, September 2003.

Identifying a Threat Focus

The next step in the threat analysis, after identifying multiple threats and mapping them by probability and likelihood, is to narrow in on one specific threat. This threat could be one threat identified within the threat map or a combination of several significant factors. Within the ASPIRE system, the threat of low public reception stands out as a something that is highly plausible and would have a significant impact on the company's success and longevity. At its most basic level this threat could be manifest in a low reception among buyers, or the threat could develop in more drastic ways, such as public resistance or conspiracy theories. This threat could have a serious impact on ASPIRE because the company's operational success and ability to secure funding is reliant on its technology being accepted broadly.

ASPIRE's success could be threatened by opposition from community stakeholders—a group that includes government leaders, infrastructure installation crews, residents, and business owners—who may be disposed to significant resistance against ASPIRE. This public hostility could be stimulated by conspiracy theories and eventually lead to widespread distrust of the company and even violence against its infrastructure. Current trends of rapidly spreading conspiracy theories suggests that this is a plausible threat, and the heavy reliance of ASPIRE's success on public support suggests that this threat would have a strong impact on the company. Community dissatisfaction, fueled by conspiracy theories would include short-term physical or long-term social damage to ASPIRE. The likelihood of the threat is highest when ASPIRE reaches its operational stage.

There are several potential causes for low public adoption. These include fears about the safety of wireless roadway charging for personal health, such as concerns about chargers causing cancer or interfering with pregnancy or pacemakers. ASPIRE's public adoption rates may also be lowered by concerns about cost or inconvenience in buying new electric vehicles that are compatible with charging technology. Community stakeholders who feel frustrated or ostracized by ASPIRE's wireless charging technology appearing in their neighborhoods could become unified in public resistance to ASPIRE's technology. Workers, such as mechanics or road crews, could perceive ASPIRE technology as a threat to their typical employment. At the most extreme level, public resistance could grow to violence if people are united by anti-EV or even anti-ASPIRE conspiracy theories.

Community Dissatisfaction Could Support Fear-Based Anti-EV Conspiracies that May Damage ASPIRE

ASPIRE is reliant on government funding and public support, which gives taxpayers an increased sense of ownership in the company's actions and could leave dissatisfied community members in a disposition that is susceptible to existing anti-EV conspiracies. Community stakeholders may feel frustrated or even ostracized by this new technology and its presence in the community.⁴⁴ Negative perception could rise to the level of a serious threat if disgruntled community members banded together, potentially under the pressure of conspiracy theories or influence from lobbyists in fields that are negatively impacted by EV technology, like oil and gas

⁴⁴ Jaxon Tolbert, "Beyond Cities: Breaking Through Barriers to Rural Electric Vehicle Adoption," *Environmental and Energy Study Institute*, 22 October 2021;

Amy Rogin, "How Can Policymakers Ensure the Push for Electric Vehicles Doesn't Harm Low-Income Communities and Communities of Color?" *Urban Institute*, 16 September 2021.

development.⁴⁵ In this case, the specific actors could be community organizations,⁴⁶ adherents to anti-EV conspiracies.

Conspiracy theories about electric vehicles are already a present concern; for example, anti-Tesla conspiracy theories have led some people to harass Tesla owners and shareowners.⁴⁷ Protestors motivated by conspiracy theories about electric vehicles could lash out against ASPIRE.⁴⁸ Often, the most potent conspiracy theories are politically motivated, which could be leveraged against ASPIRE because electric vehicles have historically been supported by the Biden administration.⁴⁹

Conspiracy theories and public fear that form around new technology are a common trend that has increased in the last decade.⁵⁰ It would be advantageous for ASPIRE be aware of conspiracies about 5G internet and COVID-19 vaccines that sprouted from distrust of new technology and government intervention.⁵¹ These theories have spread widely and begun to have tangible impact, evidenced in lower rates of coronavirus vaccine adoption.⁵² A similar fear about unfamiliar technology could fuel public distrust of ASPIRE.

Discontented Community Members Motivated by Fear or Finances Could Stand Against ASPIRE

Community stakeholders that threaten to stand against ASPIRE would likely be motivated by personal beliefs and fears or by financial incentives. One deep root of conspiracy theories is a fear around change and new technology, and fear can be a strong motivator.⁵³ In the examples of 5G and anti-vaccine theories, the conspiracies are rooted in a distrust of science or technology and a resistance against government pressure. Both sets of beliefs could be turned against ASPIRE; it is a technology-based firm with roots in climate science and climate change mitigation, and ASPIRE has received government funding. When ASPIRE reaches its operational stage, people might perceive its presence in the community as a threatening overstep in government power and an imposition on individuals' personal transportation decisions.

Community members could also come to stand against ASPIRE because of financial motivations, such as people who have built their lives and careers in industries that are dependent

⁴⁵ Kelly, Sean. "5G Conspiracy Theories and Other Popular Delusions." *Skeptic (Altadena, CA)* 26, no. 3 (2021): 34-37;

Chris McGreal, "How a Powerful US Lobby Group Helps Big Oil to Block Climate Action," *The Guardian*, 19 July 2021.

⁴⁶ Will Englund, "Without Access to Charging Stations, Black and Hispanic Communities May Be Left Behind in the Era of Electric Vehicles," *The Washington Post*, 9 December 2021.

⁴⁷ Johnna Crider, "Amplifying Anti-Tesla Conspiracy Theorists Isn't A Good Look For Consumer Reports," *CleanTechnica*, 1 October 2021.

⁴⁸ Jessica Wolf, "How Conspiracy Theories Emerge – and How Their Storylines Fall Apart," *UCLA Newsroom*, 25 June 2020.

⁴⁹ The White House, "FACT SHEET: The Biden-Harris Electric Vehicle Charging Action Plan," *The White House Briefing Room*, 13 December 2021. <https://www.whitehouse.gov/briefing-room/statements-releases/2021/12/13/fact-sheet-the-biden-harris-electric-vehicle-charging-action-plan/>

⁵⁰ Joel Rose, "More Dangerous And More Widespread': Conspiracy Theories Spread Faster Than Ever," *National Public Radio*, 2 March 2021.

⁵¹ Travis M. Andrews, "Why Dangerous Conspiracy Theories about the Virus Spread So Fast—and How They Can Be Stopped," *The Washington Post*, 1 May 2020.

⁵² Meese, James, Jordan Frith, and Rowan Wilken. "COVID-19, 5G Conspiracies and Infrastructural Futures." *Media International Australia* 177, no. 1 (2020): 30-46.

⁵³ Douglas, Karen M., Robbie M. Sutton, and Aleksandra Cichocka. "The Psychology of Conspiracy Theories," *Current Directions in Psychological Science* 26, no. 6 (2017): 538-542.

on existing transportation technology or industries that are threatened by a shift to EV technology.⁵⁴ This could include mechanics, engineers, and people who are comfortable and reliant in the lifestyles they currently have.

Short- and Long- Term Threats Plausible, Likelihood Increases During ASPIRE’s Operational Stage

Public resistance from community members could be made manifest in physical threats to ASPIRE infrastructure in the short-term or the spread of misinformation against the company that creates an environment of social distrust in the long term. The threat of community members acting against ASPIRE has not occurred in the past, primarily because ASPIRE is currently in early development stages.⁵⁵ The projection for this threat is set for ASPIRE’s future operational stages when the company has installed infrastructure within communities and is more present in public view. The probability of the threat is likely to grow over time given the current political climate of polarization and rapid spread of conspiracy theories.⁵⁶ In the near-term, the threat of public resistance against ASPIRE’s operations is low, but likely to increase alongside growth in the company’s research developments. ASPIRE could benefit by setting preparations in its early stages that would mitigate negative outcomes in the future.

The short-term, tactical goal of disgruntled community stakeholders may be to damage or deter ASPIRE’s progress in installing infrastructure and maintain the status quo of gas-powered vehicle dependence. This goal could be manifested through physical damage to ASPIRE infrastructure by breaking charging panels or disrupting construction.

The long-term, strategic goal of the threat actors could be to dissuade against electric vehicle technology. People motivated by fear, financial stability concerns, or conspiracy theories may hope to erase the threat of this new technology and continue with the perceived stability of gas-powered vehicles. This long-term objective could be achieved through spreading social distrust of ASPIRE’s technology so that the company cannot achieve market acceptance.

The threat of resistance from community stakeholders has a high likelihood of occurring and could have a large impact on ASPIRE’s operations. A resilient response that builds community relationships would not only help ASPIRE deter threats, but would likely increase the company’s long-term success and government support.⁵⁷

Identifying System Properties

In the threat analysis process, the next step after identifying a specific threat is to take a deeper look at the interactions between the various pieces within the system. ASPIRE’s system is largely built of its various engineering teams, which are connected through the company’s central leadership. There are other important parts of the system, such as the administration, policy, or market intelligence teams. Material nodes within the system are also essential, including the company’s pilot projects across the US. Visually mapping these systems offers a comprehensive perspective for the system’s operations and interactions.

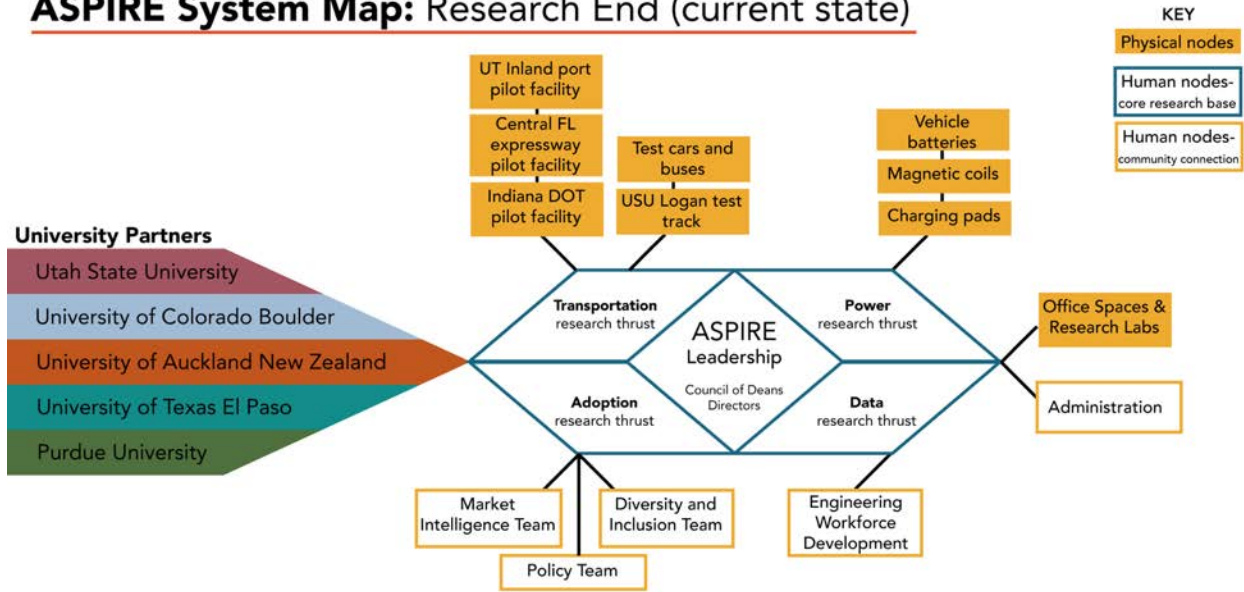
⁵⁴ Noam Scheiber, “What Will It Take for Electric Vehicles to Create Jobs, Not Cut Them?” *The New York Times*, 22 September 2021.

⁵⁵ Joseph Glandorf, “On the Move: Unpacking the Challenges and Opportunities of Electric Vehicles,” *Environmental and Energy Study Institute*, 5 November 2020.

⁵⁶ “Widening Divides: Conspiracy Theories and Political Polarization,” *Reuters*, 18 June 2021.

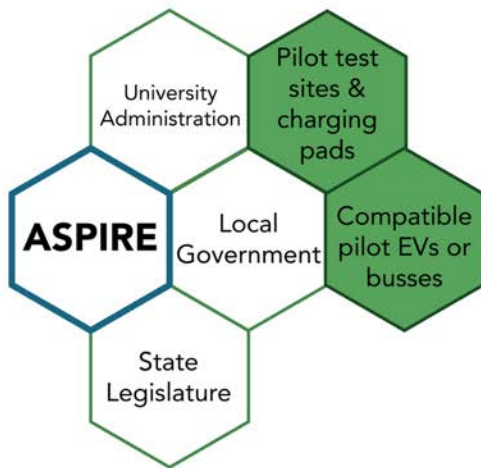
⁵⁷ Mike Anthony, “The Electric Car Conspiracy Theory,” *Inside EVs*, 27 December 2014.

ASPIRE System Map: Research End (current state)



ASPIRE System Map: Community End

Current State



Future State

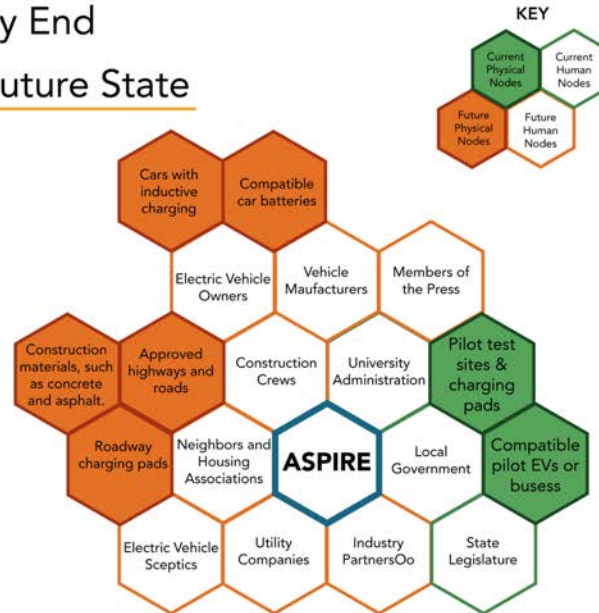


Figure one: System map that captures community interactions

Community Interactions and Research Components Vital to Understanding ASPIRE System and Vulnerabilities

This system map analyzes the ASPIRE research organization and was created in consideration of the threat of public resistance to the development of ASPIRE EV wireless charging technology. Since this threat targets ASPIRE’s relationship with the community, I dedicated one section of my system map to the interactions between ASPIRE and community entities. ASPIRE is a new company and has not yet been fully introduced to the community, so I set my threat analysis for ASPIRE’s future operational stages when the company has installed

infrastructure within communities.⁵⁸ To reflect this unique, time-sensitive analysis, I examined both the current and future states of ASPIRE's community operations in the system map. Additionally, mapping community engagement within this system does not provide enough depth of understanding of ASPIRE's functioning, so I added a second section to my system map to explain the inner workings of ASPIRE's research processes.

The research section of the system map captures the human resources that comprise ASPIRE and the system's physical nodes. One core element of ASPIRE's functioning is that the research organization is housed across five universities.⁵⁹ Every team within the ASPIRE company is made of students and faculty from various universities, and understanding this geographically integrated operating approach is key to understanding ASPIRE.⁶⁰ This is reflected in the system map in the list of universities on the left side that funnels into the diagram that shows the company's teams.⁶¹ This next section of the diagram shows ASPIRE's core research function, which is its four primary research thrusts. These thrusts are reliant on other human and physical components;⁶² for example, the transportation thrust uses pilot facilities to test transport materials,⁶³ and the adoption thrust relies on insight from the community facing groups like the policy, diversity and inclusion, and market intelligence teams.

The community section of the system map builds on the Research section by zooming out to capture how the research pieces interact with consumers, governments, and others. This part of the system is critical in understanding how the threat of community resistance could potentially hurt ASPIRE's success. The central node in this system, shown in blue outline and labeled "ASPIRE" represents the Research section of the system, as explained above. The other key nodes are shown in either green, to reflect current community interactions, or orange, to show probable future community interactions. The hexagonal pieces are nested together to show the connected nature of ASPIRE's relationships with community entities like government or industry partners.⁶⁴ The choice of multi-sided shapes arranged in a non-linear grouping is intentional, it reflects that these community counterparts interact with each other as well as with ASPIRE, and that these relationships are multi-directional. The nested arrangement is meant to demonstrate the direction of ASPIRE's community relationships, most of which are mutual and interactive. For example, construction crews installing the infrastructure are reliant on ASPIRE for employment, and ASPIRE is reliant on them for getting the infrastructure into the community.

⁵⁸ ASPIRE. n.d. "Advancing Sustainability through Powered Infrastructure for Roadway Electrification," Accessed 21 January 2022. <https://aspire.usu.edu/>

⁵⁹ ASPIRE. n.d. "Center Leadership," Accessed 21 January 2022. <https://aspire.usu.edu/people/center-leadership/index>

⁶⁰ "Purdue University to Participate in NSF-Funded Engineering Research Center to Advance Electrified Transportation," *Purdue University Newsroom*, 7 August 2020. Accessed 25 February 2022; Kelsey Simpkins, "New Engineering Research Center Aims to Electrify Transportation, Expand Education." *CU Boulder Today*, 4 August 2020. Accessed 25 February 2022; Marjorie Cortez, "Will Utah Become 'Epicenter' of Research to Electrify Transportation?" *Deseret News*, 13 January 2021.

⁶¹ ASPIRE. n.d. "Research Thrusts," Accessed 21 January 2022. <https://aspire.usu.edu/research/thrusts/index>

⁶² Kerry Hannon, "Could Roads Recharge Electric Cars? The Technology May Be Close," *New York Times*, 29 November 2021.

⁶³ "Indiana DOT Developing Wireless Electric Vehicle Charging Solution for Highway Pavements," *Roads and Bridges*, 2 July 2021. Accessed 25 February 2022.

⁶⁴ "Envirotech Vehicles Becomes Industry Member of ASPIRE Engineering Research Center," *Green Stock News*, 15 July 2021. Accessed 25 February 2022.

Assessing Resilience Components

After establishing a clear understanding of the ASPIRE system, it becomes possible to identify the areas that contribute to the system's vulnerabilities or resilience. These areas are mapped in terms of human or material resilience. This step in the threat analysis builds to a later assessment of resilience in four main categories: resistance, retention, recovery, resurgence. Visually mapping these vulnerabilities and strengths again offers perspective to areas of highest concern.

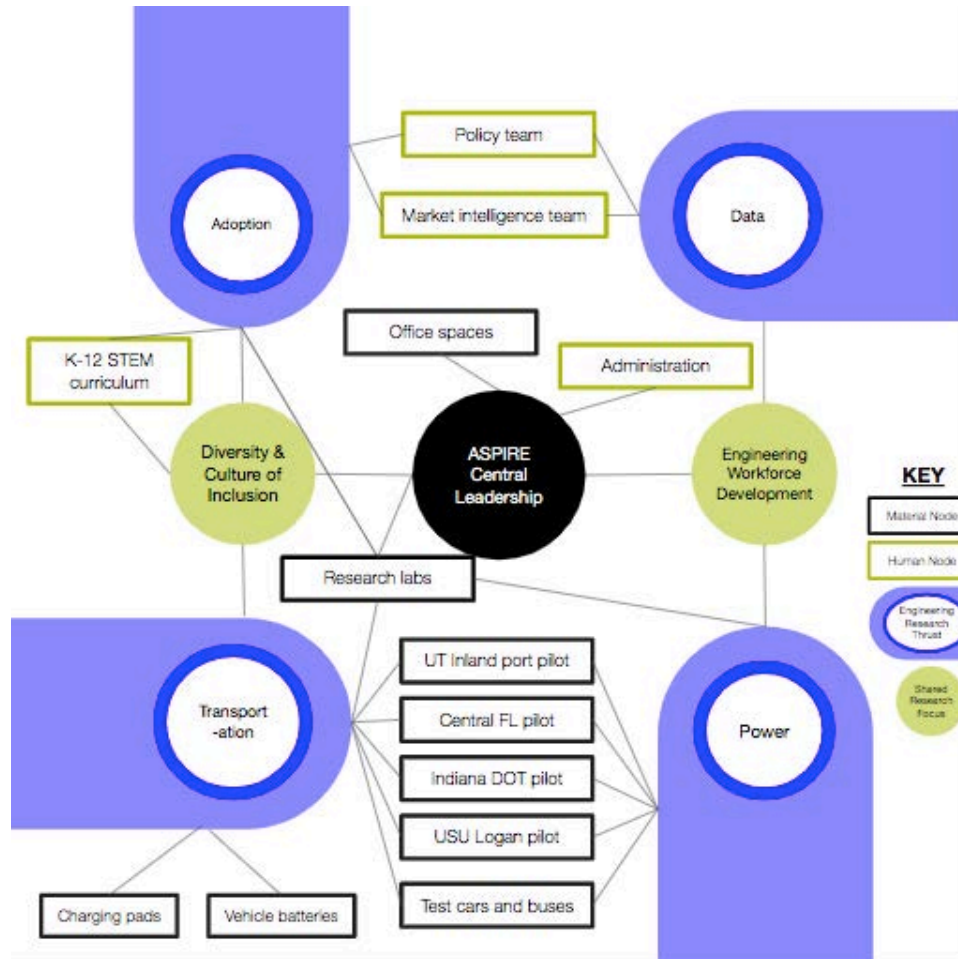


Figure 1: Updated system map. Green boxes represent human elements of the system, black boxes represent material components, blue tabs represent primary research thrusts, and black and green circles represent connecting research focuses.

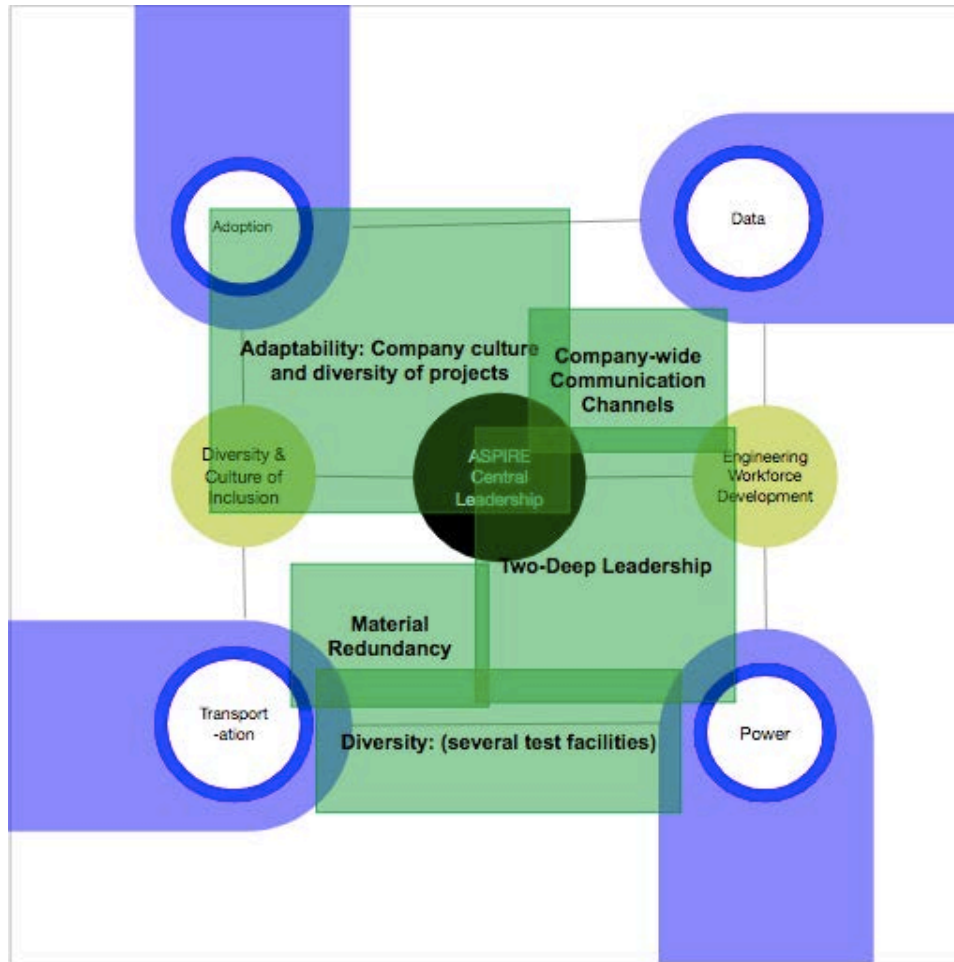


Figure 2: Simplified system map highlighting strength points. Green shaded areas represent resilience strengths in the system, as explained below. These areas are depicted by overlapping areas to represent the interwoven impact of these strengths within the system.

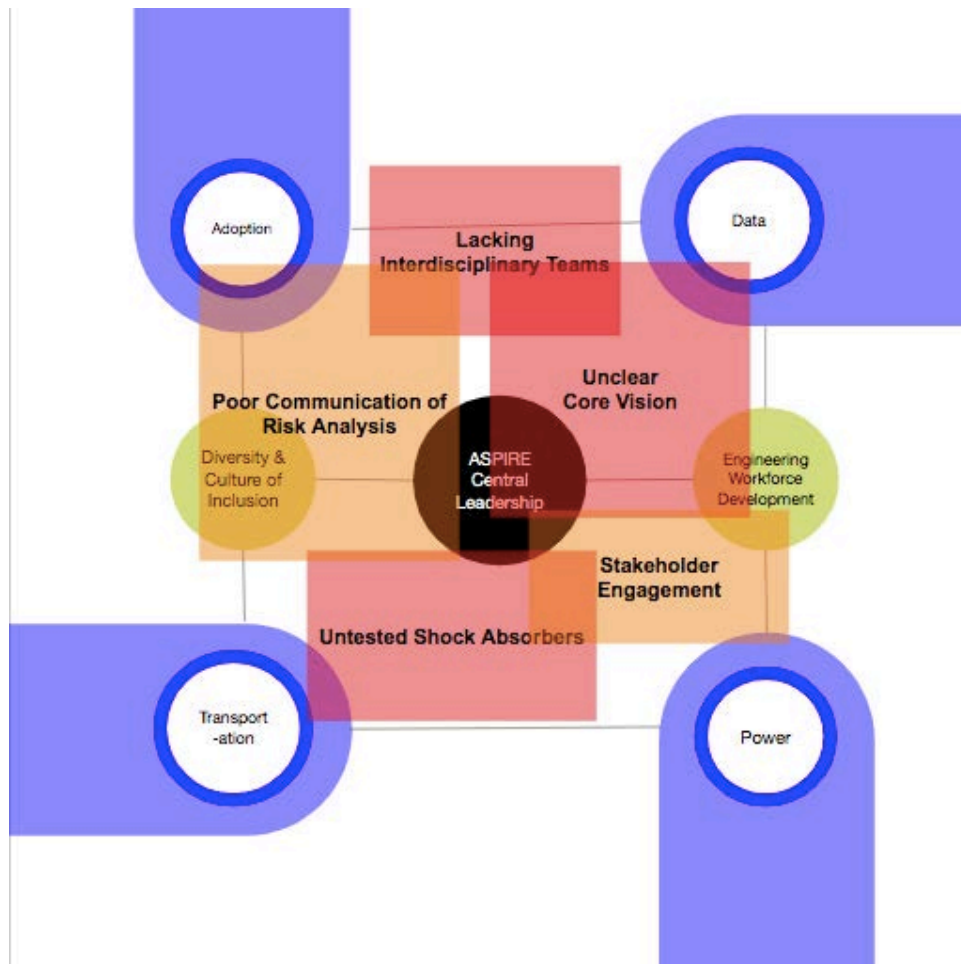


Figure 3: Simplified system map highlighting potential growth points. Red areas represent weaknesses in the system’s resilience strategies and the orange shapes represent areas where the organization has made progress but could still improve.

ASPIRE Risk Analysis: Strengths and Weaknesses

The ASPIRE system effectively runs its operations with a few key strengths that support its resilience against threats. These strengths include diversity in materials and facilities, redundancy of operations across multiple university campus partners, clear communication across the entire system, an adaptable research framework, and a “two-deep” leadership framework that prepares the system for agile transitions. The organization has some areas where it could improve its resilience strategies, including through better communication of core vision and risks, more interdisciplinary teams, tests of shock absorbers, and more extensive community stakeholder engagement.

Material Components of Resilience:

There are areas of redundancy within overlapping portions of ASPIRE’s material framework because the organization’s structure is dispersed across several universities worldwide.⁶⁵ On every campus, there are engineers working on each of ASPIRE’s research

⁶⁵ ASPIRE. n.d. “Research Thrusts,” Accessed 21 January 2022. <https://aspire.usu.edu/research/thrusts/index>

thrusters, which means that there is overlap in the material resources used across the company, such as batteries, test vehicles, and engineering labs.⁶⁶ These overlaps are useful because they ensure some ability for the company to recover in the face of a physical threat. Since research is shared across several engineering labs, if one lab were damaged then others could keep operating.

ASPIRE's multi-campus structure also provides strength through diversity. There is variety in its structure because it is comprised of several varied elements, including several different campuses, test sites, and prototypes.⁶⁷ The material variety intersects with human elements because the ASPIRE's mission is divided up into many different research focuses, each backed up with a team of researchers that bring in diverse viewpoints. These varied elements have strength in their dissimilarity. For example, in ASPIRE's pilot facilities in Indiana, Florida, and Utah, there are differences in each site that help give critical insights back to the engineers across the company.⁶⁸ Finally, there seems to be an appropriate balance between variety and disparity, and the widely spread-out physical locations work cohesively.⁶⁹

Although the organization is currently operating in a structure that is well adapted to diversity in its material components, there is still room for growth in human diversity in the company. The organization's focus is on engineering, but it seems to lack in other elements that are critical to successful public adoption of the company, such as a public relations team.⁷⁰ Adding diversity to the human structure of ASPIRE could benefit the group's overall resilience. Another key element of ASPIRE's material components is adaptability, which is a growing strength of the ASPIRE system. According to an interview with ASPIRE's Utah State University Campus Director Dr. Chris Fawson, the organization's strength relies on its broad mission to advance electric vehicle (EV) adoption, rather than a limited focus on certain technologies.⁷¹ Although wireless EV charging is a key focus of ASPIRE, Dr. Fawson explained that there are research focuses that the company could shift attention to if there was a major deterrence to wireless charging research.⁷² However, one piece that potentially discourages adaptability is ASPIRE's reliance on university and government support, which is entangled in slow-to-adapt, bureaucratic procedures.⁷³

Finally, while the ASPIRE team has shown some efforts to create premediated shock absorbers, this could be expanded in the future. The company is only one year old, so the system has not yet experienced serious friction from a physical standpoint. Despite this, ASPIRE's central leadership team has written a strategic plan for risk management that includes some provision for responding to system shocks.⁷⁴ Bringing in more perspectives from around

⁶⁶ "ASPIRE NSF ERC Year 1 Annual Report," *ASPIRE NSF Research Center*, 9 August 2021.

⁶⁷ Tallis Blalack (Managing Director, ASPIRE Research Center) in discussion with the author, 24 March 2022.

⁶⁸ Chris Fawson (Professor of Economics, Utah State University) in discussion with the author, 23 March 2022.

⁶⁹ Carolyn Karakashian Campbell (People Experience Officer, ASPIRE Research Center) in discussion with the author, 24 March 2022.

⁷⁰ ASPIRE. n.d. "Center Leadership," Accessed 21 January 2022. <https://aspire.usu.edu/people/center-leadership/index>

⁷¹ Chris Fawson (Professor of Economics, Utah State University) in discussion with the author, 23 March 2022.

⁷² Ibid.

⁷³ "ASPIRE NSF ERC Year 1 Annual Report," *ASPIRE NSF Research Center*, 9 August 2021.

⁷⁴ Ibid.

the company or from outside sources could help anticipate future threats and then center leadership could create more plans to test the company's ability to withstand or recover from these threats.

Human Components of Resilience:

One area of potential weakness for ASPIRE is alignment on views of core function because the organization's clear purpose is not universally communicated. While the public-facing appearance of ASPIRE portrays it as a research institution focused on the development and distribution of wireless charging technology, conversations with two of the company's directors shows that the company's core function is different from what is typically communicated. Dr. Chris Fawson explained that the organization's real purpose is not to distribute any one specific technology, but to support market-wide EV adoption.⁷⁵ Managing director Dr. Tallis Blalack offered a similar insight, explaining that ASPIRE's objective is to "drive EV infrastructure."⁷⁶ This disparity in core vision could be confusing to an outside viewer or an employee, which could be detrimental to the core strength of the company.

A strength of the organization is clear communication within the system, which builds a cohesive sense of identity and trust in the organization. ASPIRE's central leadership team has dedicated significant effort to unite various research thrusts and dispersed campus operations. ASPIRE's People Experience Officer, Carolyn Karakashian Campbell, explains that there is a dedicated effort to build cohesion at the overall organization level and within each campus.⁷⁷ ASPIRE uses the Twist communication platform to coordinate conversations across the center. Additionally, there are regular organization-wide meetings that provide opportunities to unite employees across difficult physical divides.

ASPIRE has built risk assessment into their program management, but this is also an area where the organization could grow. In their annual report, company leaders dedicated a section to a strategic plan and a risk assessment. The company recognizes that threats are inherent in their operations and they address this by gathering risk-related inputs from experts within the projects and the company's Market Intelligence Team.⁷⁸ The ASPIRE student organization, which is made up of graduate and undergraduate student researchers across its campuses, is also expected to perform a regular analysis about the company's strengths, weaknesses, opportunities and threats.⁷⁹ While these threat analyses exist, they are not communicated clearly or frequently to employees. Building threat and risk assessments into the center's training program or regular meetings would be a helpful step towards increasing awareness of threats.

One element of the organization's risk management strategy is their policy to maintain a "Two-Deep Leadership Model." Dr. Blalack explained that under this model, leaders in the company are expected to share their research and other responsibilities with at least one other team member so that others would know how to step in if one person had to leave the company.

⁷⁵ Chris Fawson (Professor of Economics, Utah State University) in discussion with the author, 23 March 2022.

⁷⁶ Tallis Blalack (Managing Director, ASPIRE Research Center) in discussion with the author, 24 March 2022.

⁷⁷ Carolyn Karakashian Campbell (People Experience Officer, ASPIRE Research Center) in discussion with the author, 24 March 2022.

⁷⁸ Tallis Blalack (Managing Director, ASPIRE Research Center) in discussion with the author, 24 March 2022.

⁷⁹ Amy Wilson Lopez (Associate Professor of Teacher Education and Leadership, Utah State University) in discussion with the author, 22 March 2022.

This practice was valuable in a recent situation when one of the Center’s leaders moved from the company and others could step in to manage his projects without facing a loss of information or expertise.⁸⁰

Another important piece in ASPIRE’s human components of resilience is stakeholder engagement, which is an area in which the organization has made positive progress yet also needs some improvement. ASPIRE has established relationships with many industry partners, including Toyota, Ford, John Deere, and Kenworth. These partnerships are important to the success of ASPIRE’s projects, and the company dedicates significant effort to maintaining these relationships. Additionally, ASPIRE interacts with community stakeholders with efforts like Engineering Workforce Development through STEM curriculum development or K-12 schools. However, many of these programs still have a relatively small impact and are not directed at the community members who would have the most resistance to ASPIRE technology. Better engagement of core community stakeholders could be an important step in building ASPIRE’s resilience.

Resilience Score Card

The next step in this analysis process is assessing resilience across four categories: resistance, retention, recovery, and resurgence. In each of these areas, the ASPIRE organization has places where it succeeds, and other places where improvement is possible. For clarity in communication, the system’s success in each area is evaluated on a 1 to 10 scale, where 10 represented a perfect result.

The ASPIRE system is at a level of intermediate resilience against the threat of low public buy-in for its wireless charging technology. Assessed across four factors—resistance, retention, recovery, and resurgence—this report evaluates ASPIRE with a rating of 5.5 out of 10, which indicates that the organization has made significant progress in building resilience strategies but has room for improvement. Key strengths of the organization include a diverse range of research projects and an enthusiastic attitude toward adaptation and growth. The company could improve its community relations and preparation for public adoption. Lack of attention paid to the social components of public acceptance of the project could become the Achilles heel of ASPIRE’s operations.

Resistance - Score: 5

In the face of the threat of lack of public buy-in within the ASPIRE system, the organization has some capability for resisting threat, thanks to community partnerships that exist already.⁸¹ However, these partnerships are not a primary focus of the company and could be expanded further to ensure better threat resistance.⁸²

Currently, ASPIRE has two branches of its operations that are directed at community engagement. The first is the Engineering Workforce Development (EWD) branch, which involves training within K-12 schools, community colleges, and universities.⁸³ The second is the Diversity, Community, and Inclusion (DCI) branch, which includes some outreach to communities that could be potential recipients of ASPIRE technology.⁸⁴ The EWD and DCI

⁸⁰ Tallis Blalack (Managing Director, ASPIRE Research Center) in discussion with the author, 24 March 2022.

⁸¹ Amy Wilson Lopez (Associate Professor of Teacher Education and Leadership, Utah State University) in discussion with the author, 22 March 2022.

⁸² Author observations from ASPIRE Semi-Annual Conference, 28 March 2022.

⁸³ “ASPIRE NSF ERC Year 1 Annual Report,” *ASPIRE NSF Research Center*, 9 August 2021.

⁸⁴ *Ibid.*

functions are interwoven with ASPIRE's other research thrusts, which indicates the company's positive progress to include conversations about community engagement across the company.⁸⁵

However, there are still several weak points in ASPIRE's community outreach efforts. The EWD branch focuses mainly on education systems, which does not represent a majority of the key stakeholders in those who would be impacted by ASPIRE technology.⁸⁶ ASPIRE would benefit by increasing outreach to those stakeholders, including neighborhood associations, city councils, and concerned community members. ASPIRE's current focus is on training future engineers;⁸⁷ expanding this to include community education about ASPIRE's products could have long-term resistance benefits.

In a recent ASPIRE system-wide conference, increasing public perception of the company's work was an important focus of many conversations, which signals that this is a relevant area for the company to focus on. One of the center's directors, Tallis Blalack, explained, "We're doing amazing work, but most people don't know we exist." He posed this question to others in the crowd, "How do we communicate to our external audience what we do at ASPIRE?"⁸⁸ The company is beginning to move slowly in the direction of public perception, with a recent hire of a community relations director and a potential effort to increase social media outreach, but these efforts are still a minor part of the system's overall focus. Increasing the focus on community engagement would be beneficial for the resistance of a threat.

Retention - Score: 6

ASPIRE's structure as a conglomerate of several diverse research focuses allows it to retain its core function of advancing electric vehicle (EV) research,⁸⁹ even if one of its key projects were to fail because of lack of public buy-in. This report focuses on the threat of ASPIRE's wireless charging research to fail because of lack of public buy-in; in this scenario, ASPIRE could retain its function by diverting resources and attention to a different project.

The company's research portfolio is quite broad, even though the outward facing perception of the organization makes it seem like wireless EV charging is its primary purpose.⁹⁰ Interviews with leadership in the company revealed that there are other research functions that are just as much a priority.⁹¹ Wireless charging is ASPIRE's most prominent research project, especially in consideration of information on the company website and the presence of its wireless charging pilot programs in Utah, Florida, and Indiana. However, there are other pieces of research that are less well-known to the public but are important within in the inner structure of the company.⁹² These projects include XFC (extra fast charging) wired charging, city power systems, and data development systems.⁹³ While these projects and several others are all related to the EV market, few of them are directly connected to wireless charging.

Chris Fawson, ASPIRE's USU campus director, explained that the system's broad goal to improve EV adoption across the market rather than focus only on one narrow function improves the company's adaptability and longevity.⁹⁴ Dr. Fawson explained that the company plans to be

⁸⁵ Aspire website ASPIRE. n.d. "Research Thrusts," Accessed 21 January 2022.

<https://aspire.usu.edu/research/thrusts/index>

⁸⁶ Author observation from ASPIRE Semi-Annual Conference, 28 March 2022.

⁸⁷ Author observation during ASPIRE Semi-Annual Conference, 28 March 2022.

⁸⁸ Author observation of a presentation from Tallis Blalack in ASPIRE Semi-Annual Conference, 2022.

⁸⁹ Chris Fawson (Professor of Economics, Utah State University) in discussion with the author, 23 March 2022.

⁹⁰ "ASPIRE NSF ERC Year 1 Annual Report," *ASPIRE NSF Research Center*, 9 August 2021.

⁹¹ [1] Chris Fawson (Professor of Economics, Utah State University) in discussion with the author, 23 March 2022.

Tallis Blalack (Managing Director, ASPIRE Research Center) in discussion with the author, 24 March 2022.

⁹² ASPIRE. n.d. "Center Leadership," Accessed 21 January 2022. <https://aspire.usu.edu/people/center-leadership/index>

⁹³ Author observation from several presentations at the ASPIRE Semi-Annual Conference, 28 March 2022.

⁹⁴ Chris Fawson (Professor of Economics, Utah State University) in discussion with the author, 23 March 2022.

adaptable over time and shift attention between projects.⁹⁵ In this scenario, a strong focus on wireless charging could be replaced by other projects in the future. This suggests that the company can retain its basic research framework and even retain funding in the case that there is damage to one of the research arms.

While the company's widespread research focus is potential strength for ASPIRE's retention capability, the system also is at the risk of being spread too thin. As a relatively new company that is divided across several geographic locations, the system is already at risk of being spread out too far for true unity of vision and purpose. Adding to this a wide range of projects that are not all closely interconnected, the system may be playing too much into its diverse project range.

Recovery- Score: 4

The ASPIRE system has a reduced ability to recover from the threat of lack of public buy-in because of the company's strong reliance on public funding. The company is supported by a ten-year grant from the National Science Foundation (NSF), as well as some other funding from additional grants and funds from industry partners.⁹⁶ If ASPIRE wireless charging projects were successful in pilot research but failed to achieve public support or use, the company would have a difficult time proving its worth to potential funding sources. A potential threat would be costly to the company, especially in terms of the lost time and resource investments into research and development. Recovering funding after suffering from this threat would be a challenge to ASPIRE, especially in that this specific threat is something that could potentially be preventable.

The threat of lack of public buy-in on the ASPIRE wireless charging project falls within a blind spot of the company. The company is primarily comprised of engineers who are focused on complicated, technical research projects.⁹⁷ However, there are few people within the company that are focused directly on how the project will be adopted. There is a research arm focused on adoption, but this team is more focused on technical elements of installation such as construction factors or concrete development rather than the social factors at play in adoption.⁹⁸ If ASPIRE is complacent to the social components of wireless charging adoption, the company may have a more difficult time proving its worth when securing funding.

Resurgence - Score: 7

One key strength of ASPIRE is the enthusiasm its members have for the company's mission and a shared drive to help the company succeed in the face of risks.⁹⁹ ASPIRE's director has a risk focused mindset, the company has included risk analyses in their reporting strategies, and individual members seem to be eager to prepare for and grow from risks or changes.¹⁰⁰ The system has a heightened ability to bounce back from challenges because leaders and members keep risks in mind in their development phase and are focused on maintaining an adaptation-oriented mindset.

Starting with central leadership, ASPIRE has focused on keeping a mindful eye towards preparedness and adaptation. The tone is set by the ASPIRE Center Director, Reagan Zane. At the most recent center-wide conference, Dr. Zane explained to ASPIRE members that adaptation was an important part of his approach to dealing with challenges at ASPIRE, saying "I've been talking about risks since day one."¹⁰¹ This is evident in the preparation strategy of the company.

⁹⁵ Ibid.

⁹⁶ Author observation at ASPIRE Semi-Annual Conference, 28 March 2022.

⁹⁷ Author observation from several conversations with ASPIRE employees at ASPIRE Semi-Annual Conference, 28 March 2022.

⁹⁸ Author observation from ASPIRE Semi-Annual Conference, 28 March 2022.

⁹⁹ Author observation during risk-analysis activity at ASPIRE Semi-Annual Conference, 28 March 2022.

¹⁰⁰ Author observation during presentation from ASPIRE Director Regan Zane at ASPIRE Semi-Annual Conference, 28 March 2022.

¹⁰¹ Ibid.

In their extensive annual report, there is a section dedicated to anticipating risks.¹⁰² This is an important step, and something that could be expanded in the future.

The mindset of risk awareness and willingness to build the system back after being impacted by a threat is something that is shared across the company. During the system-wide conference, Dr. Zane conducted an exercise in which all ASPIRE members had to come up with threats that could impact ASPIRE and potential paths to addressing these threats.¹⁰³ The collective attitude of participants during this exercise was eager and enthusiastic, giving the impression that ASPIRE members were dedicated to adapting to risks and threats. This is promising in terms of the company's resurgence potential.¹⁰⁴ In the face of the threat of public buy-in, the company's collective disposition is favorable to recovery and even growing stronger because of the threat.

One point of apprehension within the company's resurgence capability comes from potential holdbacks within ASPIRE's academic approach. ASPIRE's structure is made up of several university partners and the company has a strong foundation in academia.¹⁰⁵ While this is a strength in the caliber of research being conducted in the organization, the company is at risk of lagging behind fast-paced, market-driven companies.¹⁰⁶ ASPIRE's funding from the NSF and their base in university research spaces could be a disadvantage to their ability to bounce back quickly in a competitive market.

Resilience Recommendations

Finally, after assessing several aspects of the ASPIRE system and analyzing the threat of public resistance, the most important step in this process is the recommendation of future actions to improve the system's resilience.

Overarching Recommendation:

Prioritize public adoption as a key focus of ASPIRE's center wide efforts and devote more time resources to increasing the public adoption of ASPIRE's technology.

Specific Recommendations:

Achieve the goal of expanding public adoption efforts to increase by following a multi-level plan. The levels can be implemented separately and are organized by required effort and resources. The three-step recommendation is to build training and project reporting standards, develop marketing efforts, and increase industry and community partnerships.

Level One: Training and Project Reporting

The first recommendation is to add an evaluation of adoption potential to current project reporting standards across all ASPIRE research projects. This solution brings the public-facing element of ASPIRE's work into all its varied research focuses, thereby ensuring that all of the technology the company is developing will have success in the community and not simply die on the shelf.

Within ASPIRE, there is a strong focus on engineering and technical aspects of research, while far less attention is devoted to the public-facing aspects of the projects and the eventual adoption of technology.¹⁰⁷ Adding an evaluation of adoption potential as an extra step for every research project could encourage the engineers and project managers to focus on more than just

¹⁰² "ASPIRE NSF ERC Year 1 Annual Report," *ASPIRE NSF Research Center*, 9 August 2021.

¹⁰³ Author observation during risk analysis activity at ASPIRE Semi-Annual Conference, 28 March 2022.

¹⁰⁴ Ibid.

¹⁰⁵ ASPIRE. n.d. "Center Leadership," Accessed 21 January 2022. <https://aspire.usu.edu/people/center-leadership/index>

¹⁰⁶ Author observation at ASPIRE Semi-Annual Conference, 28 March 2022.

¹⁰⁷ Author observations at ASPIRE Semi-Annual Conference, 28 March 2022.

the technical success of their innovations. This evaluation could include a summary of what resources would be needed to ensure the project's adoption in a community and an assessment of risk or setbacks that could deter adoption.

The implementation of this suggestion would require additional training, especially because most ASPIRE employees are trained in engineering and are likely to have less expertise in social sciences or marketing. Additional training to prepare employees to evaluate public adoption factors could be added to existing training modules. More specifically, the suggested training would not be an effort to transform every engineer a marketing specialist, rather to have them identify potential needs or risks related to their project, and ensure that all employees are constantly considering how their project will be adopted in communities.

This suggestion adds value to ASPIRE because it helps shift company culture towards greater focus on public reception. Currently, the primary focus of the company is on technical innovation, which creates a potential blind spot towards community relationships and public adoption.¹⁰⁸ The implementation of this suggestion could also improve ASPIRE's resurgence capability, in that it builds a company culture that is focused on the threat of low public buy-in and is prepared to bounce back from this and adapt to challenges.

The requirements for this suggestion include the costs of developing and implementing new training. There would also be added time, cost, and effort for restructuring current reporting systems and ensuring that all employees are following the new guidelines in their projects. Fortunately, this suggestion would have low material needs because it leverages existing training and reporting resources. The benefit of this suggestion is that it improves upon existing systems within the organization, which increases solution's cost effectiveness and functionality.

Level Two: Develop Marketing Efforts

The next suggestion is to hire new people to focus specifically on increasing efforts to improve public buy-in efforts. A team of marketing and public relations specialist could orchestrate marketing efforts and better community outreach. Additionally, this team would be expected improve communications across the company to build unity of vision throughout the different projects and relay this information to key stakeholders outside of the company. The team could also prioritize include education to communities about the safety and usefulness of ASPIRE technology.

As mentioned previously, most ASPIRE employees are engineers who are focused primarily on the technical success of their projects.¹⁰⁹ In this setting, bringing in new employees from non-STEM and non-academic backgrounds could be beneficial in bringing in new ideas and priorities to current conversations.¹¹⁰ This could be an important step to changing the pace and bringing a sense of urgency to projects, as well as to the need for public interaction with the projects. The recent hire of a new Innovation Director within ASPIRE's central leadership who comes from an international business background is a wise move towards integrating new perspectives into ASPIRE's initiatives.¹¹¹ The suggestion to build marketing efforts could follow the momentum of this new hire.

Heeding the recommendation to develop new marketing efforts could add value to the company increasing ASPIRE's visibility and its likelihood of acceptance within communities. This could increase the company's resistance against the specific threat of low public buy-in because it would increase community's awareness of the new technologies.

¹⁰⁸ Author observation from ASPIRE Semi-Annual Conference, 28 March 2022.

¹⁰⁹ Ibid.

¹¹⁰ Spalter-Roth, Roberta. "Recruiting Minorities, Women, and Social Science Majors into the STEM Workforce: Alternative Paradigms for Human and Social Capital Development."

¹¹¹ Author observation from meeting new Innovation Director at ASPIRE Semi-Annual Conference, 28 March 2022.

Implementing this suggestion requires the hire of new employees, something that would entail a talent search and increased budget for salaries. Subsequent budget increases would be needed to orchestrate the marketing initiatives that the team implements. ASPIRE leadership would also need to take time to create a plan for communicating between the marketing team and the many facets of ASPIRE's operations. The benefit of meeting these requirements would be worthwhile because the added financial cost to bring in new marketing personnel will likely pay off if ASPIRE can improve its public perception, which in turn improves the company's success and longevity.

Level Three: Increase Partnerships

The final suggestion is to build partnerships with industry members and community stakeholders to improve public awareness of the company. The company could leverage and expand upon existing partnerships and prioritize boosting its public presence in new partnerships. Since ASPIRE is a research-focused, academia-based organization, a tendency to focus primarily on technical projects and research deadlines could generate complacency towards building relationships in communities.¹¹² Establishing industry and community partnerships as a clear priority within ASPIRE could help the company become more resilient and successful, and it could increase the sense of urgency for developing technology and ensuring its successful adoption.

ASPIRE could increase its visibility if it partnered with other organizations that had more brand familiarity within communities. Bringing in more community partnerships could increase awareness and acceptance of ASPIRE's technology. For example, to address public fears about the safety of wireless charging technology, ASPIRE could partner with community public health providers to educate people about the benefits of ASPIRE's EV technology (such as the reduced emissions and benefit for air quality), and help quell fears about why the wireless technology does not present health concerns.¹¹³

The suggestion to increase partnership brings value to ASPIRE's current operations because it adds a sense of urgency and importance from industry partnerships and market pressures to offset possible lags from academic timelines. Additionally, it improves ASPIRE's recovery potential by building out more funding opportunities from industry partners who could financially support ASPIRE's projects. Increasing partnerships also shows potential funding sources that ASPIRE is a worthwhile investment with ties to the community and industry that improve the company's longevity and success.

This suggestion could be implemented at a low or high scale, depending on the resources ASPIRE chooses to allocate and the desired level of results. If ASPIRE hoped to build strong partnerships with prominent companies at a high level, it would require either the hiring new personnel to manage partnerships or adding responsibility for current ASPIRE leadership. Once partnerships are established, there will be additional costs in time and money to coordinate projects and send out educational materials. These costs could pay off in ASPIRE's increased resilience by increasing the company's overall adaptability and public visibility.

¹¹² Ibid.

¹¹³ Choma, Ernani F., John S. Evans, James K. Hammitt, José A. Gómez-Ibáñez, and John D. Spengler. "Assessing the health impacts of electric vehicles through air pollution in the United States." *Environment International* 144 (2020): 106015.

Vreugdenhil, Gerard. "Electric vehicles. A small step towards improving air quality and mortality?." *European journal of internal medicine* 37 (2017): e9-e10.

Conclusion

The analysis of vulnerabilities and preparation against threats is vital to prolonging the well-being of any organization. ASPIRE is a prime example of a successful organization that could be made even stronger by implementing strategies to improve its capability to withstand and back bounce from threats. Incorporating feedback from a threat analysis prepares a company to be more adaptable in a variety of ways, and not just against the threat that is the focus of the threat analysis. An organization that is open to assessing its own adaptability and implementing resilience strategies for one threat is more likely to cultivate an attitude of preparedness that carries across many situations.

The threat assessment in this report revealed that ASPIRE is an organization that has several strengths that can be developed continually, and a few places of potential growth. I was excited to see an attitude of resilience and adaptability within the company's workforce, which offers hope for the company's ability to implement the recommended resilience strategies. Some of the weaker points in ASPIRE's framework, such as a potential lack of multidisciplinary perspectives in its workforce, could be addressed promptly to improve not only the company's threat resilience but also its overall quality. Additionally, implementing the recommendations suggested to increase the public adoption of ASPIRE technology could offer significant benefits to the company's resilience and bring in potentially surprising benefits like exciting new partnerships that offer interesting growth opportunities.

The threat analysis framework developed in the Center for Anticipatory Intelligence (CAI) program and applied here is useful for widening a system's consideration of its resilience potential. In completing this analysis, I was surprised to learn that it is common for systems to remain unaware of threats, especially when many of the threats are easily overshadowed in the urgency of day-to-day operations. The CAI threat analysis framework is useful in providing a systematic and exhaustive evaluation that provides approachable results with a clear path for implementation. However, the CAI framework is still in its beginning stages and has some aspects that could be improved. I felt that bringing in interdisciplinary perspectives throughout the process, could have offered important insights that I may have missed in my evaluation. Additionally, I saw that primary research through contact with the ASPIRE organization was an important part of later steps in the process, but I felt that this direct contact with the system could have been encouraged in earlier steps. One path to achieving this could come through working directly with an assigned partner within the system during each step of the evaluation. Overall, the CAI threat analysis framework has strong potential to be a useful tool for a variety of organizations that are looking to improve their adaptability and resilience.

Word Count: 11,018 words

Reflection

For the last four and a half years while I have been at USU, much of my academic experience has been guided by the Honors program motto, “Dare to Know.” My capstone project pushed me to continue daring to learn new things, and daring to bring together years of work in one cumulative project. My capstone project helped me learn to think critically, build a relationship my mentor, and synthesize much of what I learned throughout my undergraduate education. I am so grateful that I had the opportunity to work closely with Dr. Jeannie Johnson and benefit from her thoughtful and supportive mentorship. This project was important to me because it gave me an opportunity to dare to learn about something interesting and new, and challenged me to continue daring to learn as I progress into my career after graduation.

This project was a perfect capstone for my undergraduate education because the subject area covered several of the interests I have pursued in my classes and extracurricular involvement. Additionally, this capstone project required the use of an array of skills that I have developed over my education, including detailed research, technical writing, information visualization, and conducting interviews.

This project added to my educational experience because it challenged me to combine several of my interests in a clear and meaningful way. My favorite part of this project was finding ways to communicate my research findings in both writing and visual formats. I have always loved art and graphic design, and this project gave me an opportunity to incorporate my interest in visual art. One of my biggest takeaways from my college education is that my creativity and propensity to communicate with visuals is a strength that can be harnessed in any endeavor, even one that is not expressly artistic. For this reason, this project acts as a true capstone for my college education, which has been a journey of developing my skills for both visual and written communication. In this project, I spoke often with Dr. Johnson about how to use graphic design to convey my research. She helped me see that I could make my research more clear and approachable if I incorporated a graphic representation for certain elements, such as a system map.

Completing the threat resilience evaluation for my capstone gave me analysis and presentation skills that are essential to my future career. Specifically, I plan to work as a business consultant after graduation, a job that requires the ability for research, information synthesis, and concise summarization. I will be given difficult problem sets and expected to deliver recommendations for the client’s future success. Working on my capstone project, I had to follow a similar pattern in my research by first analyzing the problem, then coming up with a course of action, and finally reaching a suggestion that I could communicate to stakeholders. I am grateful for my capstone experience because it gave me confidence in my ability to perform tasks that will be essential in my future work as a consultant.

One of the most fulfilling parts of my capstone experience was building a relationship with my mentor, Dr. Johnson. She helped me learn several practical lessons that applied to the success of the project, like how to smoothly incorporate visual materials into technical research paper or conduct primary research through interviews. Dr. Johnson also helped me learn how to communicate my suggestions professionally and clearly to stakeholders, which can be a difficult balance to strike when trying to give someone a correction on their work. Even more important than the practical lessons I learned from Dr. Johnson, her mentorship was meaningful to me because she taught me by example about being passionate and dedicated. I am impressed by Dr. Johnson’s ability to develop a vision and then find a path to execute it. Throughout my project, when I hit stumbling block, Dr. Johnson helped me find a way to work around it or grow from it.

I also felt Dr. Johnson's passion in the way she interacted with me and supported me in my project. She was supportive and kind, and I could tell that this project and my success in completing it were important to her. At the close of this capstone process, Dr. Johnson's pride and excitement in my work was palpable, and seeing this was one of the best gifts I could have received. Her kindness towards others and passion about their success is something that I admire in Dr. Johnson and something I hope to implement in my future education and career. Dr. Johnson's mentorship showed me the importance of caring deeply about other people and supporting them wholeheartedly.

This capstone project was important to me because it allowed me to apply concepts that I have learned from many classes in both of my majors. This project helped me expand on skills that I developed in past research projects, and this was useful in making me think critically about an array of things that I have learned in various major-related classes. I have been fortunate to have completed several research projects in my International Studies major and working on this project brought together many of the things I learned in those projects. For example, I worked with a sociology professor on a research journal article that looked at sustainability from a social development angle. That project taught me about how to incorporate community viewpoints in considering large scale issues, which is something that I directly implemented in my capstone project by examining the community outreach branch of ASPIRE. As I evaluated this aspect of ASPIRE's work, I had to think critically about my research findings and weigh out what would be the best recommendation to offer at the conclusion of my work. I was surprised to find that it took courage to make this recommendation, especially because it challenged the status quo. It was important for me to think about the problem from several angles so that I could confidently share my conclusion and be supported by my research findings.

I am grateful for what I learned in this capstone because it helped me stretch across disciplines and learn from people who had different academic experiences from mine. Since I was researching ASPIRE, an engineering research organization, I had the chance to interview several people from the organization who worked in engineering disciplines. It was fascinating for me to learn about their expertise and realize how different it was from my work in economics and political science. Even though I saw some significant differences, I also like learning about the things that our disciplines shared, like critical thinking skills or a need for collaboration. This process helped me see that better outcomes are usually reached when perspectives from across several disciplines are brought together.

Learning about ASPIRE for my capstone project helped me engage with my local and national community. I got to learn about ASPIRE's work on its research campus in Logan, as well as its outreach to community partners and schools. Additionally, I engaged in the broader network of ASPIRE partners across the country, including researchers from Purdue, University of El Paso, and University of Colorado Boulder. I enjoyed learning from a variety of people from different backgrounds, and I also felt that my work could have an impact for them. The outcome of my research was a recommendation that could improve the way that ASPIRE interacts with the community and the eventual reception of ASPIRE electric vehicle technology in cities around the country. It is exciting for me to realize that my research could play a small part in increasing electric vehicle adoption and improving sustainability and health outcomes in several communities.

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Author Biography

Madeleine Alder studied Economics and International Studies at Utah State University with minors in Russian and International Studies. From her first day as a USU student, Madeleine has prioritized academics and found joy in pushing herself in the classroom. This is shown in her exemplary grades, as well as her involvement in several research projects such as the Center for Anticipatory Intelligence, Research on Capitol Hill, Aggies Geopolitical Observatory, Peak Research Fellowship, and Institute for Land, Water, and Air. She gained recognition for bringing an artistic touch to any project touched and has seen her artwork featured in Connections course curriculum and USUSA promotional material. Madeleine has been an Aggie since birth and is driven by a deep love for her USU community. She puts others first, evidenced by her service as USUSA Chief of Staff, cohort leader in the Huntsman Scholar program, and creator of the Sustainable CHaSS initiative. She leads with kindness and concentrates on inclusion. Following graduation, Madeleine will work as a business analyst for Cicero Group, a management consulting firm in Salt Lake City, Utah.