
# ACCELERATING CHANGE THROUGH AIRMEN UNDERSTANDING OF AUTOMATION AND EMERGING TECHNOLOGIES

GRADUATE RESEARCH PAPER

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**Abstract**

The Chief of Staff of the Air Force, General Charles Q. Brown, Jr has charged Airmen to *Accelerate Change or Lose (ACOL).* In order to do so, it is necessary to foster innovation and provide viable and sustainable pathways for innovative ideas. Emerging technologies such as automation and artificial intelligence are types of innovation currently being implemented throughout the Air Force.

The purpose of this research was to determine what information Airmen at various levels should know regarding automation and emerging technologies in order to accelerate change. In order to do so, common themes were identified in organizations that have implemented innovation projects. By identifying positive trends and common barriers, other organizations can adapt their practices to foster a culture of innovation. When Airmen are aware of these trends and barriers, they will know what paths are available to implement their own projects or assist others to implement similar projects.

The benefits of this research are inherent to furthering General Brown's ACOL initiative; however, the potential lessons learned from this research can be applied beyond the Air Force to other military branches and even to organizations outside the military.

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# I. Introduction

## Background

In August 2020, the 22nd Chief of Staff of the United States Air Force, General Charles Q. Brown, Jr. released his strategic approach entitled *Accelerate Change or Lose (ACOL)*. General Brown describes the current operational environment which is characterized by declining resources, aggressive global competitors, and rapid technology development (Brown, 2020). This ever-changing operational environment drives the need to accelerate change within the Air Force.

When talking about accelerating change, it is important to discuss what type of change is being targeted. Change is common in the military with personnel constantly being restationed and new commanders taking over organizations every 2-3 years; however, General Brown's call to change refers to the need to adapt the way the Air Force acts and reacts (Brown, 2020). Innovation, or coming up with new ways to operate, is a key aspect of this potential adaptation and emerging technologies unlock many new possibilities. The use of emerging technologies such as artificial intelligence and automation will enable the Air Force to evolve and fight in highly contested environments. In this introduction, General Brown's concepts that detail the need to accelerate change will be discussed in order to demonstrate some of the possible innovation opportunities and applications of emerging technologies.

## Declining Resources

The concept of declining resources is a common theme throughout recent history of the Department of Defense. The U.S. Air Force already faces increasing budget pressure based on growing costs of sustainment for current and aging force structure, continuous combat operations, inflation, and long-deferred modernization (Brown, 2020). These increasing costs are coupled with other significant factors such as changing political climates calling to cut defense budgets and historical events like sequestration. In order to accelerate change, it is necessary to explore all options to increase efficiency while minimizing resource utilization. Secretary of the Air Force Frank Kendall spoke to this need while discussing the proposed 2023 budget. He stated "We have to get rid of…legacy equipment in order to have the resources to modernize" (Losey, 2022).

Private industry also faces challenges that drive a need for innovation. While they may not be worried about literal war with their competitors, failure to adapt and keep pace with competitors could lead to the end of their business. Industry also faces constraints on resources such as lack of access to skilled labor, financial issues such as access to debt or inflation, and the need to modernize operations (Basu, 2016).

## Good Enough Today Will Fail Tomorrow

One of the main points of General Brown's strategic approach is titled "Good Enough Today Will Fail Tomorrow". General Brown states:

> *Unlike the past, much of the emerging technologies that will determine our future are no longer created or funded by the Department of Defense. The processes with which we build capabilities for our Airmen have not adapted to these changes; the ways in which we test, evaluate, and train with them do not meet current or future*

> *demands. While we have made progress, our Airmen need us to integrate and accelerate the changes necessary to explore new operational concepts and bring more rapidly the capabilities that will help them in the future fights. (p. 4-5)*

Technological advancements make innovation possible because they enable new forms of operations that may not have been technically possible in the past. Since the Wright brothers made their historic first flight in 1903, the aviation industry has seen significant technological advances. Aircraft flight was an emerging technology at the time of the Wright brothers and over the past 119 years there have been several other emerging technologies, such as the jet engine and supersonic flight, that are now common technologies.

The world is currently in the middle of another significant advancement from emerging technologies. Referred to as Industry 4.0, I4.0, the 4$^{th}$ industrial revolution, or 4IR, this new revolution is focused on optimizing the advancements of computers that are already in place (Marr, 2021). Artificial intelligence and its subdisciplines such as machine learning are an integral part of I4.0 (Chae & Olson, 2021) and their applications have already helped many businesses improve their operations. For example, an African gold mine was able to use machine learning to identify previously-unknown fluctuations in oxygen levels, and by resolving these fluctuations they were able to increase their yield by 3.7% (Baur & Wee, 2020). The Air Force has also started implementing these technologies, such as the use of artificial intelligence and machine learning to process terabytes of data collected in reconnaissance operations (SSQ, 2017).

**We Must Collaborate Within and Throughout to Succeed**

Another main point of General Brown's strategic approach is titled "We Must Collaborate Within and Throughout to Succeed". General Brown challenges us:

> *We must candidly assess ourselves and address our own internal impediments to change…Likely future budget pressures will require the most difficult force structure decisions in generations. We cannot shy away from these decisions. The U.S. Air Force already faces increasing budget pressure based on growing costs of sustainment for current and aging force structure, continuous combat operations, and long-deferred modernization. While previous decisions were made with the best intentions reflecting perceived needs at the time, in aggregate, they do not deliver the outcomes we need today due to the rapidly-changing elements of the competitions with China and Russia. Learning from prior recapitalization and modernization plans, we must frame decisions with an enterprise-wide perspective. We need to examine our structures and decision-making to force the hard conversations and effect the changes we need." (p. 5)*

The difficult force structure decisions mentioned by General Brown will likely lead to a leaner Air Force. The U.S. Army is already evaluating plans to reduce its force structure through the use of robotics (Ackerman, 2021) and the Air Force is likely evaluating similar courses of action. Technological advancements make it possible for these changes in force structure. In fact, STARA (smart technology, artificial intelligence, robotics, and algorithms) advancements are projected to have such a profound impact that 47% of the US workforce has a high probability of having their jobs automated in the next two decades (Frey & Osborne, 2017). In a recent study commissioned by Ernst & Young, nearly half of the executives in consumer goods operations stated they believe it's critical for *all* business functions to operate differently in the near future (Holloman & Basile, 2022). The Air Force, as well as private business, will need to decide what force reductions are needed and what jobs can be transformed.

**Empowering Airmen Can Solve Any Problem**

The final point of General Brown's strategic approach that will be discussed is entitled "Empowering Airmen Can Solve Any Problem". General Brown states:

> *Our Airmen must be multi-capable and adaptable team builders, as well as innovative and courageous problem solvers, and demonstrate value in the diversity of thought, ingenuity, and initiative. We must develop leaders with the appropriate tools to create and sustain an environment in which all Airmen can reach their full potential, valuing the many aspects of diversity within our Air Force. (p. 6)*

Many businesses in private industry have attempted to utilize their employees for innovation. Firms that utilize grassroots innovation outperform firms that do not (Stremersch et al., 2022). Nestle and ING are examples of companies attempting to leverage this effort. As of December 2021, Nestle's Employee Innovation Accelerator known as InGenius has received over 9750 ideas from Nestle employees worldwide. These ideas are then refined until they can be pitched to executives for the chance to be funded and executed (InGenius, 2022). ING's efforts to hold their annual Innovation Bootcamp aims at empowering employees to turn smart ideas into reality. In 2015 this effort generated over 1800 submissions, of which the top 100 ideas competed for funding and implementation (ING.com, 2015).

The Air Force has also made strides at empowering employees. In 2017, the Secretary of the Air Force established AFWERX, which is the innovation arm of the Air Force. Along with several other enabling tasks, AFWERX overseas Spark Cells at many Air Force installations which act as local resources to facilitate innovation projects (Chimento, 2020). The Air Force has also introduced the Squadron Innovation Fund (SIF) which provides funding to be used on

potential innovation projects at the wing and squadron level. By providing funding down to the squadron level, it enables innovators to get the root of some of the most common problems. It also reduces competition for funding since funding stays within the allocated squadron. Earlier attempts to promote innovation at a wing level provided significantly less funding that was often absorbed by higher-level initiatives (Chimento, 2020).

## Problem Statement/Research Focus

The purpose of this research is to determine what information Airmen at various levels should know regarding automation and emerging technologies in order to accelerate change. As detailed above, there is a significant need to accelerate change in the Air Force and several existing projects exist with the intent of fostering innovation. By determining what Airmen should know, it will be possible for them to further innovation.

## Limitations/Assumptions

The study assumes that the automation and emerging technologies projects referenced by interviewees are taking place at the local level. It also assumes that the projects are being championed by Airmen and face the challenges of an upward approval chain. Another name for this is grassroots innovation. Grassroots innovation aims to promote innovation from any employee regardless of his/her position (Stremersch et al., 2022). The study does not target projects that are championed by large organizations which have the organic ability to implement projects. Projects championed by these larger organizations often originate as a directive to solve a specific problem rather than grassroots innovation efforts. When projects originate from such directives, some of the barriers to approval/implementation are immediately removed.

The selection of interview candidates was limited to persons who have experience with emerging technologies within the Air Force. This allows the responses to be formulated from first-person accounts. Selection of interview candidates is detailed in the methodology section.

## Implications

This research can inform commanders and other "gatekeepers" about the importance of promoting innovative projects rather than consciously or unconsciously creating a culture that stifles innovation. By identifying positive trends and common barriers, other organizations can adapt their practices to foster a culture of innovation. When Airmen are aware of these trends and barriers, they will be able to know what paths to take to implement their own projects or assist others to implement similar projects. The benefits of this research are inherent to furthering General Brown's ACOL initiate; however, the potential lessons learned from this research can be applied beyond the Air Force to other military branches and even to organizations outside the military.

## Summary

Section 1 of this paper serves as an introduction to the research problem and provides background information on the issue as well as the assumptions and limitations of the research. This background will be expanded upon later in the paper through literature review and sections addressing the methodology, results, and recommendations of the study.

## II. Literature Review

### Section Overview

The purpose of this literature is to provide background understanding of innovation topics such as automation and artificial intelligence. It will also explore broader systematic topics such as obtaining leadership buy-in and barriers to implementation. Past innovation studies within the Department of Defense and private industry, especially conducted via grounded theory will also be described.

### Artificial Intelligence

Artificial intelligence (AI) is simply defined by Encyclopedia Britannica as the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings (Copeland, 2022). While AI is a commonly used term, many people still lack a basic understanding of what it is and the potential issues that come along with this field of technology.

In the March 2019 Air Force Law Review, Maj Aaron Kirk discusses the range of artificial intelligence and the legal/moral concerns that accompany the technology. Artificial intelligence can refer to a broad range of products. On one end of the spectrum, it can include simple digital assistants such as Google Assistant, Alexa, and Siri; however, on the opposite end of the spectrum it can also describe autonomous weapon systems (AWS) such as the SGR-1 sentry robot. The legal and moral concerns of a digital assistant center mostly around privacy concerns; however, the legal and moral concerns of an AWS that can track and eliminate targets without human input are exponentially more complex (Kirk, 2019).

Part of the concern with AI in military applications such as the AWS is the concept of "black-box" operations when inputs come into the system and a decision is made, but the reasoning and calculations aren't transparent. Maj Kirk explains "the extent to which an AI program is capable of explaining its decisions ultimately translates to the degree to which a human operator can trust the AI's decision" (Kirk, 2019).

Artificial intelligence uses various methods to mimic "thinking" such as machine learning, deep learning, and neural networks. The purpose of this paper is not to explain these processes or the nuanced differences between them; however, it is important to note that the goal of each process is to mimic the human brain's ability to process data (Kirk, 2019). This is a very complex task and designing such a system requires specialized knowledge and extensive experience in computer coding. For that reason, most grass-roots innovation projects fall into the simpler realm of automation.

**Robotic Process Automation (RPA)**

Robotic process automation is a type of automation that uses software to replicate human tasks. The ideal scenario for implementation of RPA targets processes that are scalable, repetitive, and standardized (Gex & Minor, 2019). This allows a single "bot" to be created that can easily execute based off a desired input. Robotic process automation is not ideal for variable processes, because it would require a new bot to be built for each individual process. Another key distinction with RPA is the ability to implement new projects without the need for coding expertise. Several programs exist such as Microsoft Power Automate, UiPath, and Automate Anywhere allow users to create new processes through a graphical user interface. This type of development platform is a called "low-code" or "no-code" and allows nearly anyone who was previously performing a task the ability to program the new RPA program. As more companies

seek to digitize their processes, there aren't enough software engineers to meet demand so low-code and no-code solutions are also increasingly being used out of necessity (Woo, 2020).

**Leadership Buy-In**

Leadership buy-in is essential for the implementation of any new innovation product. From a budgetary standpoint, there is always a desire to reduce costs and increase manpower availability. In fact, US Office of Management and Budget Memorandum M-18-23 encourages government agencies to "develop and implement strategies for shifting resources to high-value activities…such as robotics process automation (RPA), to reduce repetitive administrative tasks, and other process-reform initiatives" (Office of Management and Budget, 2018). Unfortunately, implementation of guidance such as the memorandum referenced above isn't always uniform and doesn't take into account the risk tolerance of those charged with implementation. Risk tolerance amongst leaders varies significantly; however, risk aversion is common within the Department of Defense (Chimento, 2020). A risk-averse leader could comply with the above policy through top-down tasking and having a dedicated team develop RPA solutions for a pre-identified process. This type of command follows precedence that already exists in the military of maintaining control of processes, while meeting the basic requirements of the innovation mandate. Such precedence has low risk and is often favored by organizational leadership (Hamel, 2000). A leader that is more risk-tolerant could comply with the policy through an open invitation to all employees to explore creating their own RPA processes. This method has the potential to unlock greater innovation through a wider audience; however, it also risk becoming overly time consuming and distracting as it allows a large audience to work of a wide range of issues. A push for innovation left unregulated has the potential to be taken too far and turn into a culture of disastrous experimentation (Price, 2014).

**Barriers to Implementation**

Dr. Andrew Hill, Professor of Organization Studies in the Department of Command, Leadership, and Management the US Army War College broke down some of the innovation barriers that exist. He argued that innovation isn't a scientific or technical problem; it is an organizational challenge. The military is a highly disciplined and execution focused organization, and such organizations rarely place a high value on new and untried ideas (Hill, 2015).

Part of this resistance to change is the need for uniformity and standardization in the military. Standardization is a concept that is instilled into every servicemember from the first day of basic training. As such, it is normal that new concepts face high levels of resistance unless they come as a mandate from higher up the chain of command. This organizational endorsement gives the "green light" to implement change, while telling the implementing organization that the associated risk is well within the tolerable levels set by those in higher positions (Jeffer, 1977). On the other hand, organic innovation projects working against an upward approval trajectory require the risk tolerance to be accepted at a lower level. If the organic project fails, the leader of the implementing organization may not have the backing of their higher leadership who often times also have significant input into the military promotion system.

Dr. Hill recommends three ways forward to overcome these barriers. Firstly, leaders need to engineer the competitive context of innovation (Hill, 2015). In other words, they are responsible for fostering a culture that values indirect or organic innovation so that the full scope of the organization is used to explore and exploit new possibilities. Secondly, it is vital that officers are taught how to challenge their own assumptions (Hill, 2015). This involves teaching them how to learn, how to change their minds, and how to embrace complexity. Lastly, he

recommends that officers be given a path to success outside of the existing framework. Rather than focusing on a set career path based on a military occupational specialty, officers should be provided a path to success that fosters different ways of thinking and values breadth of experience as opposed to just depth (Hill, 2015).

**Innovation in the Department of Defense and Private Industry**

The Department of Defense has already implemented several programs to help foster innovation. In 1982, the Small Business Innovation Development Act established the small business innovation research (SBIR) program. Under this act, large federal agencies including the Department of Defense are required to spend a percentage of their budget on the SBIR program which awards contracts to small businesses to participate in federal research and development (R&D). The efficacy of this program has been praised by the Small Business Technology Council, claiming that 20% of the world's major innovation have come from SBIR program recipients (40 Years of Success, 2017). In 2018, the Air Force started expanding their SBIR program by including a new open category that allows submission of any idea that may be beneficial to the Air Force (Howell et al., 2021). By doing so, the Air Force is able to capitalize on innovative businesses that provide solutions to problems the Air Force may not even realize exist. While the Air Force excels at problem-solving once an issue is identified, often it fails to identify existing problems (Sellers, 2017).

Problem identification can be a significant barrier to beginning the innovation process; however, it can be overcome through open innovation that occurs when organizations challenge their employees to reflect on potential issues (Seltzer & Mahmoodi, 2012). Engaging employees in innovation processes has additional challenges. A grounded theory investigation of employee innovation conducted at the Queensland University of Technology found that factors such as

organizational culture, time resources, and problem types significantly influenced the level of engagement amongst employees (Unsworth, 2003). Other grounded theory research has also been conducted exploring business model innovation such as the study of Chinese high-end equipment manufacturers, Culture and resource constraints were also identified as factors in this study, but government policy was also identified as a significant factor (Tian et al., 2019).

# III. Methodology

## Overview

The overarching research questions being studied is: What do Airmen need to understand about the implementation of emerging technology and automation in order to accelerate change across the Air Force? This research question is exploratory in nature and a qualitative approach was needed. Rather than develop a theory to be tested, a grounded theory approach was selected in order to allow collected data to answer the question rather that validate an existing hypothesis.

## Grounded Theory Process

Grounded theory is a qualitative research methodology aiming to generate theories based off collected data (Glaser & Strauss, 1967). This methodology differed from other methodologies which focus on the use of data collection to support an existing hypothesis. Grounded theory is a "no preconceptions method" (Glaser, 2016) that researches emerging patterns. General background research was performed; however, care was taken to avoid forming hypotheses before data collection and analysis. For this research, a literature review was conducted on the topics of Artificial Intelligence and Robotic Process Automation. This preliminary research was necessary for the author to gain a basic understanding of the concepts that could be discussed throughout the interview process; however, research regarding barriers and enablers of automation implementation was specifically avoided in order to avoid preconceptions. The literature review for these topics was conducted during the sorting phase of data analysis, as described later on in this section.

Data collection in a grounded theory approach primarily comes from interviews. Since grounded theory leads to theory formation rather than trying to prove a hypothesis, interview

questions were designed to be exploratory in nature. These exploratory interviews used the same set of initial questions with each participant; however, flexibility was maintained in order to adapt questioning as needed based off initial responses. Open ended questions were used to ensure maximum data collection, and also to avoid steering answers in a specific direction. A list of the initial interview questions used in this research can be found in Appendix A.

Purposive sampling, which groups participants according to preselected criteria (Mack, 2005), is one of the sampling strategies that was used for this research. The selection criteria consisted of individuals who are involved in ongoing or past efforts to affect change in the Air Force through the use of automation or other emerging technologies. Potential groups of participants included users of the new technology, implementation teams, supervisors, and commanders. The primary barrier with using this strategy was the lack of a centralized list of contacts that met the criteria.

In order to overcome this barrier and identify potential interviewees that meet these criteria, assistance was requested from the United States Air Force Tesseract Office which works to accelerate innovation within Air Force communities. A point of contact at Tesseract set up a voluntary contact roster at one of their annual events and that contact roster led to the identification of the first interviewee. At the end of each interview, additional referrals were requested in order to identify other potential interviewees. This type of sampling is known as snowball sampling and was a valuable strategy used in this situation since it allowed access to groups that weren't easily accessible via other means (Mack, 2005).

After all interviews were conducted and transcribed, the data analysis portion was conducted. This analysis consisted of coding, memo writing and sorting of the data. Qualitative coding allowed interview data to be sorted and separated for further analysis. In this stage,

segments of the interview were condensed, or “coded”, into concise terms. These concise terms allowed for common themes to be observed and collected between various interviews. As coding was conducted, memo writing allowed insight to be annotated as it occurred. This insight was vital in order to form conclusions and eventually for theory formulation.

Once coding and memo writing occurred for all the interviews, sorting and writing took place. In this stage, the coded segments and memos were grouped together based on similarities and observations. New connections were inferred that may have not be evident from the unsorted coding. These connections and recurring themes formed the basis for answering the research question.

# IV. Analysis and Results

## Section Overview

The analysis and results section will present the common themes that were identified during the interview process. As detailed in the methodology section, a snowball sampling method was used in an effort to find candidates that had the desired experience with emerging technologies and automation projects within the Air Force. This sampling allowed for seven candidates to be identified and interviewed. While this sample size is small compared to the overall population of the Air Force, the interviews rapidly converged on several recurring themes. All of the interview candidates were male and each candidate met the desired criteria of being involved in emerging technologies or automation at a grassroots level. Each interview was transcribed and then coded to identify common themes amongst the interviews. In order to maintain anonymity, identifying characteristics were removed from their responses and during this analysis they will simply be referred to as Interview Candidate (IC) and a number (i.e. IC1, IC2). Through the interview coding process, four common themes stood out in the majority of interviews.

## Experience Level

The first recurring theme regards the experience level needed to champion a new innovation project. When asked how much experience he had with automation or emerging technologies before starting his project, IC6 responded:

> *"Nothing, I just nosedived into it for about two months and figured it out, but it's called low-code/no-code for a reason. Very little background knowledge is required."* -

In the majority of cases, the interviewee had little or no experience with emerging technologies or automation before the project they tried to implement within the Air Force. Lack of experience in these fields was clearly not a discriminating factor since the programs discussed were successfully implemented; however, it should be noted that each of the champions did possess the technical expertise relevant to the task that they were innovating.

The concept that prior experience in innovation is not a precursor to success is reinforced by the previously discussed Nestle InGenius and ING Innovation Bootcamp efforts. In both examples, like the results of this study, the primary factor that led to success was identifying a problem and knowing that creative solution could be formulated (InGenius, 2022; ING.com, 2015). Once the idea was in place, other resources were able to be used to bridge the gap to implementation. None of the interviewees cited experience or significant expertise in the field of an emerging technology as a precursor to effectively implementation of a project.

IC7 was an outlier amongst the other ICs due to his experience in automation and AI prior to joining the Air Force. Before enlisting, he co-founded a business that utilized machine learning to capitalize on the education tutoring market. His Air Force projects took a similar trajectory for approval and implementation as the other projects; however, the project itself relied heavily on advanced coding techniques outside the knowledge of a typical Airmen. When asked about whether Airmen could successfully implement a project without the same level of technical expertise, he responded:

> *If [an Airmen] has no technical skills, I would push him in the direction of a no-code environment where he could start prototyping.*

Although IC7 didn't need to rely on these resources, he stressed that the ambitions of the project champion and the desire to implement change can overcome lack of experience. IC7's

experience in successfully implementing his project faced similar barriers to the other projects. Even with his technical experience that enabled him to code the new solution, he still relied on external assistance from Tesseract for mentoring through the innovation process.

### Spark Cells & Other Innovation Centers

The second recurring theme is assistance from an innovation center such as the installation Spark Cell or Tesseract. IC5 spoke about his experience:

> *I think Spark Cells need to be implemented and more spoken about to other individuals. I feel like in general Spark Cells don't get the credit they deserve. I don't feel like everyone knows the innovation side of the Air Force. You have people who have the checklist mindset, or it's too scary for some people. The biggest buy-in for me was working with the innovation cell.*

Spark Cells are base level innovation centers that seek to capitalize on Air Force intrapreneurs (Spark Cells, 2019). Interviewees consistently stated that members of their local Spark Cell organization helped them bridge the gap between their personal knowledge and implementation of their project; albeit to varying degrees. Spark Cells provided mentorship and contacts which allowed Airmen to connect with other innovative organizations such as AFWERX, SAF/CN, Tesseract, and the Defense Innovation Network. In some cases, the Spark Cell was also able to act as a liaison between the project champion and local leadership to obtain buy-in.

### Buy-in from Leadership

Buy-in from local leadership is the third recurring theme and is an important aspect in the implementation of organic innovation projects. The majority of respondents stated that local leadership, usually squadron or group levels, are the "make or break" gatekeepers of the

innovation process. IC7, who admitted that his leadership was exceptionally supportive in allowing him time to work on his project, stated:

> *Having groups that have some sway behind them, that can come in and validate an airmen's idea [is key] … then local leadership is more likely to give them space. If every unit would be willing to give [an Airman] the time and space to pursue something that would actually improve processes in the long term, I think that the Air Force would be a very different place.*

When a champion was able to gain the approval of his local leadership, his project was often able to reach high levels of exposure; however, often times local leadership served as a barrier rather than an enabler. Acting in a gatekeeper capacity, local leaders have the ability to either promote or discourage further progress on innovation projects. The perception of leadership as a barrier was discussed by multiple interviewees. IC1 stated:

> *There's a lot of juggling to try and keep the right people in the loop, because you don't want them to kill the project but you do need their support…In the early stages when I brought this idea up (this was pre-innovation push within the Air Force where there's heavy support from the higher leadership), a lot of the responses were either "you're not going to be able to do that in the Air Force, it takes so long to get anything going" or "why don't you get out and do that on the outside as a contractor."…It was killing the idea without necessarily having to listen too much to it or spend too much time on it. So, I think in the early stages if I were to listen to that, then the idea would have died fairly quickly*

IC6 shared similar sentiments and stated that he started implementing his project and then "asked for forgiveness rather than permission" because he was sure that his leadership would never have

approved the project at the beginning. This resistance by middle management, or local leaders in the case of the Air Force, is often referred to as the frozen middle. Reactions to the frozen middle vary greatly. Some wonder if it ever truly existed and view the term as a cultural excuse to avoid work (Trew, 2018), while others encourage us to reflect on whether we're part of the problem. Former Chief of Staff of the Air Force General David Goldfein stated, "There is a long line of Airmen waiting to be innovative and tell us how to do things better. There's an even longer line of old folks, like us, waiting to tell them no." (Moyer, 2020)

**Feasibility of Change**

Another barrier that Airmen face to implement their projects is knowing what can be changed. This is the final common theme that was identified throughout the interviews. As discussed above, technical expertise was usually not a barrier to implementation; however, many interviewees agreed that there is a barrier to Airmen knowing what is technically feasible. IC1 stated"

> *[For AI], Airmen need to know a lot to actually suggest something feasible…It's hard to ID whether it's a problem set for AI or whether a different innovation would be more beneficial.*

IC7 echoed similarly statements:

> *To educate people on what's feasible would be great, but the Airmen on the ground are better at identifying the constraints rather than the solutions…Educate someone that has the bigger picture for the implementation portion…the biggest barrier is that a lot of people don't have the perspective to think that something could be automated…99% of people will keep filling out forms manually given the chance.*

These comments are in line with existing studies and the barriers detailed in the above Literature Review. While the Air Force excels at problem-solving once an issue is identified, often it fails to identify existing problems (Sellers, 2017). In the case of emerging technologies, it also seems to be a case that Airmen are unaware of the potential for process improvement. By introducing Airmen to existing projects that have been implemented, it would be possible to improve innovation potential within their own workplace.

# V. Conclusions and Recommendations

## Conclusions of Research

This research highlighted the process that many organic innovation projects take from idea to implementation. As shown in Section 4, many of the scenarios encountered in this research involved persons with little to no experience that found a way to break through barriers and successfully implement their program. Clearly experience and expertise is not necessary to be the champion of a potential project; however, general consensus shows a basic understanding of what is possible would benefit the Air Force innovation culture as a whole.

Barriers have always existed and they will continue to exist in various forms; however, the Air Force is working to remove many of these barriers through the Spark Cell initiative and higher initiatives such as AFWERX and Tesseract. The networking power of these organizations and their ability to expand the audience of a potential project is one of the strongest tools currently available to Airmen. These organizations can serve a crucial role of validating Airmen ideas and fostering wider involvement in innovation projects.

Local leadership buy-in is also important to consider. Senior leader tools such as General Brown's ACOL strategic approach continue to stress the importance of innovation; however, it is evident that the "frozen middle" still exists either in practice or in perception.

## Recommendations for Action

The primary recommendation of this research is for Airmen at all levels to foster an environment that allows innovative ideas to thrive. It is of the researcher's opinion that the Spark Cell construct is one of the most valuable and underutilized resources available today. Airmen at all levels are also recommended to visit their local Spark Cell to see what resources are available.

It is also recommended to explore existing innovation programs to determine what may be possible in their own organizations.

For local leaders and frontline supervisors, it is recommended to personally explore the resources available to your organization and determine how you can increase awareness amongst Airmen. It is also recommended to perform a self-evaluation to determine openness to innovation and how current local policies either promote or deter experimentation.

For senior leaders, it is recommended to continue support of Spark Cells and other innovation programs throughout the Air Force. Strive to incorporate the Spark Cells as a vital part of operations and not just as an extra resource that people can explore at their leisure. Senior leaders should be aware that the "frozen middle" still exists in some locations and that there is a wide range of risk tolerance when it comes to supporting innovation. Innovation and the appropriate culture to encourage it should be topics of constant discussion. Targeted questions relating to these topics should be highly considered when conducting organizational climate assessments.

**Future Research**

There are several potential pathways forward to expand on this research. In order to gain more perspectives, it would be possible to continue the interview process from this research and expand it to wider audiences. The pool of interviewees could be expanded by including members of other armed services and possibly even innovators from civilian organizations. As innovation continues in the Air Force, the number of innovators will naturally increase as well.

There is also an opportunity to expand this research through the existing Spark Cell structures that exist. By interviewing Spark Cell participants, the researcher would automatically have a large pool of qualified candidates to interview. This line of research would also allow

comparisons to occur between Spark Cells at different bases which could lead to the identification of future best-practices that could be shared with other organizations.

As noted in the results above, resources such as Spark Cells and AFWERX often play a large role in facilitating innovation. Another research avenue that could be explored is whether Airmen at various levels are aware of these resources that are available and what the perceptions are regarding these resources.

One final path for future research would be a study focused on commanders and their risk tolerance towards innovation. This research could prove beneficial to understand some of the barriers of implemented innovative programs. It could also be used as a teaching tool for new incoming commanders as well as a metric to determine how well General Brown's ACOL initiative is being received.

## Bibliography


*40 Years of Success: SBIR drives America's High Tech Economy Technology Innovation, Competitiveness and High Quality Jobs.* Testimony Before the Senate Committee on Small Business & Entrepreneurship.116th Cong. (2017). https://smallbusiness.house.gov/uploadedfiles/05-13-21_mr._glover_testimony.pdf

Ackerman, E. (2021, June 24). *U.S. Army considers replacing thousands of soldiers with robots*. IEEE Spectrum. Retrieved August 17, 2022, from https://spectrum.ieee.org/army-considers-replacing-thousands-of-soldiers-with-robots

Basu, C. (2016, October 26). *What constraints are placed on business in the economy?* Small Business - Chron.com. Retrieved August 7, 2022, from https://smallbusiness.chron.com/constraints-placed-business-economy-33982.html

Baur, C., & Wee, D. (2020, October 20). *Manufacturing's next act*. McKinsey & Company. Retrieved August 6, 2022, from https://www.mckinsey.com/business-functions/operations/our-insights/manufacturings-next-act

Brown Jr, C. Q. (2020). *Accelerate change or lose*. United States Air Force.

Chimento III, C. W. (2020). *Open innovation in the US Air Force* (Doctoral dissertation, Massachusetts Institute of Technology).

Copeland, B. (2022, March 18). *artificial intelligence*. Encyclopedia Britannica. https://www.britannica.com/technology/artificial-intelligence

Frey, C. B., & Osborne, M. A. (2017). *The future of employment: How susceptible are jobs to computerisation?* Technological Forecasting & Social Change, 114, 254–280.

Gex, C., & Minor, M. (2019). Make your robotic process automation (RPA) implementation successful. *Armed Forces Comptroller*, *64*(1), 18-22.

Glaser, B. G., & Strauss, A. (1967). *The discovery of Grounded Theory: Strategies for qualitative research*. Aldine Publishing Co.

Glaser, B. G. (2016). *The Grounded Theory Perspective: Its Origins and Growth. Grounded Theory Review*, 15(1), 4–9.

Hamel, G. (2000). *Leading the Revolution: How to Thrive in Turbulent Times by Making Innovation a Way of Life*. MacGraw-Hill.

Hill, A. (2015). Military innovation and military culture. *The US Army War College Quarterly: Parameters*, *45*(1), 9.

Holloman, D., & Basili, S. (2022, January 28). *How consumer goods companies can address the duality of resilience and growth*. EY. Retrieved August 7, 2022, from https://www.ey.com/en_us/consumer-products-retail/how-consumer-goods-companies-can-address-the-duality-of-resilience-and-growth

Howell, S. T., Rathje, J., Van Reenen, J., & Wong, J. (2021). Opening up military innovation: Causal effects of 'bottom-up' reforms to U.S. Defense Research. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3825034

ING.com. (2015, June 25). *Innovation bootcamp: More than 1800 ideas from Ing Employees-*. ING.com. Retrieved August 7, 2022, from https://www.ing.com/Newsroom/News/Features/Innovation-Bootcamp-More-than-1800-ideas-from-ING-employees.htm

Ingenius. (n.d.). Retrieved August 7, 2022, from https://ingenius-accelerator.nestle.com/about

Jeffer, E. K. (1977). Problems of Organizational Consultation in the Army. *Administration in Mental Health, 5*(1), 68–74. https://doi.org/10.1007/bf00820963

Kirk, A. D. (2019). Artificial intelligence and the fifth domain. *AFL Rev., 80*, 183.

Losey, S. (2022, March 29). *Air Force would cut 150 aircraft, including A-10s, buy fewer F-35s in 2023 budget*. Defense News. Retrieved August 7, 2022, from https://www.defensenews.com/air/2022/03/28/air-force-would-cut-150-aircraft-including-a-10s-buy-fewer-f-35s-in-2023-budget/

Mack, N. (2005). Qualitative research methods: A data collector's field guide.

Marr, B. (2021, December 10). *What is industry 4.0? here's a super easy explanation for anyone*. Forbes. Retrieved August 6, 2022, from https://www.forbes.com/sites/bernardmarr/2018/09/02/what-is-industry-4-0-heres-a-super-easy-explanation-for-anyone/?sh=62dd0b3f9788

Office of Management and Budget, Memorandum for Heads of Executive Departments and Agencies Shifting from Low-Value to High-Value Work, August 27, 2018, whitehouse.gov.

Price Jr, J. F. (2014). *US military innovation: Fostering creativity in a culture of compliance*. Air University Maxwell AFB AL Air Force Research Institute.

Sellers, J. S. (2017). Innovation in a Bipolar Air Force. Air & Space Power Journal, 31(4), 69–80.

Seltzer, E., & Mahmoudi, D. (2012). Citizen participation, open innovation, and crowdsourcing. *Journal of Planning Literature*, *28*(1), 3–18. https://doi.org/10.1177/0885412212469112

*Spark cells*. AFWERX. (2019, May 23). Retrieved August 1, 2022, from https://afwerx.com/service/charity-2/

SSQ, & Goldfein, D. L. (2017). An Interview with Gen David L. Goldfein : Twenty-First Chief of Staff of the US Air Force Conducted 5 January 2017. Strategic Studies Quarterly, 11(1), 3–13.

Stott, A. (2021, November 8). Anonymous Automation/AI Interview 1 - AFIT GRP. personal.

Stott, A. (2021, November 9). Anonymous Automation/AI Interview 2 - AFIT GRP. personal.

Stott, A. (2021, November 10). Anonymous Automation/AI Interview 3 - AFIT GRP. personal.

Stott, A. (2021, December 22). Anonymous Automation/AI Interview 4 - AFIT GRP. personal.

Stott, A. (2022, July 11). Anonymous Automation/AI Interview 5 - AFIT GRP. personal.

Stott, A. (2022, July 12). Anonymous Automation/AI Interview 6 - AFIT GRP. personal.

Stott, A. (2022, August 2). Anonymous Automation/AI Interview 7 - AFIT GRP. personal.

Stott, A. (2022, August 8). Anonymous Automation/AI Interview 8 - AFIT GRP. personal.

Stremersch, S., Camacho, N., Keko, E., & Wuyts, S. (2022). Grassroots innovation success: the role of self-determination and leadership style. *International Journal of Research in Marketing*, *39*(2), 396-414.

Tian, Q., Zhang, S., Yu, H., & Cao, G. (2019). Exploring the factors influencing business model innovation using grounded theory: The case of a Chinese high-end equipment manufacturer. *Sustainability*, *11*(5), 1455. https://doi.org/10.3390/su11051455

Unsworth, K. (2003). Engagement in employee innovation: A grounded theory investigation. *Academy of Management*.

Woo, M. (2020). The rise of No/Low Code software development—no experience needed? *Engineering*, *6*(9), 960–961. https://doi.org/10.1016/j.eng.2020.07.007

Zauskova, A., Kusá, A., Kubovics, M., Scepkova, S., & Urmínová, M. (2022). Current state and prediction of the future of digitization as a part of Industry 4.0. *Serbian Journal of Management*, *17*(1), 111-123.

## Appendix A: Interview Questions

**Preface to read before interviews**

Hello, my name is Captain Austin Stott. I am currently a Captain in the United States Air Force and am conducting research as a student at the Air Force Institute of Technology. This research fulfills my Graduate Research Project requirement as part of the Masters in Logistics and Supply Chain Management degree. My research aims to answer the question: "What do Airmen need to understand about the implementation of emerging technology and automation in order to accelerate change across the Air Force?" A grounded theory approach is being used, meaning large numbers of interviews are being conducted and recorded in order to find recurring trends and connections. Your participation in this survey is completely voluntary and can be terminated at any time. In order to ensure accuracy in transcribing interview data, interviews may be recorded; however, your name and direct quotes will not be used in the final research paper without obtaining additional consent.

**About the user:**

- Please discuss your current involvements with automation/AI within the workplace.
- What prior experience do you have with automation/AI?
- How much pre-existing knowledge of automation/AI concepts do you think Airmen need in order to work with these new processes?
- How do you feel your current exposure to this project will affect your ability to recognize potential for other projects?

**About the project:**

- Your unit has already successfully implemented an automation/AI program; do you feel there is anything special about this unit that has allowed that to happen?

- How do you feel the new process compares to its non-automated version?
- Have there been any negative aspects from the new process?
- How difficult was it for this new process to be developed and implemented?

**About the future:**

- What do you feel are the primary barriers keeping more projects and processes from being implemented?
- What role do you feel that supervision and the leadership play in effective implementation of new projects?
- How do you think the Air Force can encourage other Airmen to identify processes that could benefit from automation/AI?
- If you had a new automation/AI idea for consideration, what process would you go through to get it implemented?
- With proper implementation of automation/AI within the workplace, many manpower-intensive tasks that are performed on a daily basis could be replaced with software programs. How do you feel like this shift could affect your career field in the future?
- General Charles Q. Brown, Chief of Staff of the Air Force recently released a strategic approach entitled “Accelerate Change or Lose” in which he discusses the need to empower Airmen on all levels. What do you think senior leaders need to know in order for this to happen?
- What do you think the consequences are if we don’t continue to implement more automation/AI? Is there anything wrong with continuing to do things the way we have in the past?

- Is there anything else we haven’t discussed that you think would be beneficial for Airmen to know regarding automation/AI?

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**14. ABSTRACT**

The purpose of this research was to determine what information Airmen at various levels should know regarding automation and emerging technologies in order to accelerate change. In order to do so, common themes were identified in organizations that have implemented innovation projects. By identifying positive trends and common barriers, other organizations can adapt their practices to foster a culture of innovation. When Airmen are aware of these trends and barriers, they will know what paths are available to implement their own projects or assist others to implement similar projects.

**15. SUBJECT TERMS**

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