DIFFUSION OF AUTONOMOUS VEHICLES AS AN ORGANIZATIONAL INNOVATION

THESIS

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THESIS

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Abstract

All organizations incur costs during the adoption and diffusion of new innovations. Adoption can fail, or organizations can incur excessive costs if diffusion is executed poorly. Diffusion of innovation is a long-standing field of research, but autonomous vehicles present a rarely-seen level of disruptiveness to commercial/governmental organizations and to societal norms. This merits scrutiny of organizations with large vehicle fleets, such as the USAF. The findings of this research assess USAF readiness to adopt autonomous vehicles along extant factors from literature.
Dedication

I am thankful for Major Ben Hazen for his guidance during this messy journey. I am also grateful for my friends and family, who have always loved and supported me through the good and bad times. I am especially thankful for my wife and for her incredible strength, patience, love, and support during this difficult program, amidst the distance that’s separated us and her own arduous workload.

John D. Atkinson IV
# Table of Contents

Abstract ........................................................................................................................................ iv  
Dedication ..................................................................................................................................... v  
Table of Contents ........................................................................................................................ vi  
I. Introduction .............................................................................................................................. 1  
   Overview ................................................................................................................................. 1  
   Definition of Key Terms ........................................................................................................... 1  
   Background ............................................................................................................................... 2  
   Problem Statement .................................................................................................................... 4  
   Research Questions .................................................................................................................. 4  
   Methodology ............................................................................................................................. 5  
   Scope, Assumptions, and Limitations ....................................................................................... 6  
II. Literature Review ....................................................................................................................... 8  
   Introduction ............................................................................................................................. 8  
   Overview of Autonomous Vehicles .......................................................................................... 8  
      Cost/Benefit Analysis of Autonomous Vehicles ................................................................. 9  
      Levels of Autonomy in Vehicles .......................................................................................... 10  
   Diffusion of Innovation Theory ............................................................................................... 11  
      Theory ................................................................................................................................. 11  
      Innovation Defined .............................................................................................................. 12  
      Categories of Innovation ...................................................................................................... 13  
   Innovation Factors ................................................................................................................... 13  
      Innovation Factor Hypotheses ............................................................................................. 14  
   Organizational Factors ............................................................................................................ 15  
      Organizational Factors Hypotheses ..................................................................................... 16  
   Environmental, Individual, and Task Factors ......................................................................... 16  
   Determinants of Innovation Implementation .......................................................................... 17  
   Innovation in Bureaucracies ..................................................................................................... 19  
   Adoption Decision Model ........................................................................................................ 20  
   Proposed Research Model ....................................................................................................... 21  
   Summary ................................................................................................................................. 22  
III. Methodology .......................................................................................................................... 23  
   Overview ................................................................................................................................. 23  
   Population ............................................................................................................................... 23
List of Tables

Table 1. Autonomous Vehicle Potential Benefits and Costs (Litman, 2014) 9
Table 2. Levels of Autonomous Vehicles (Litman, 2014) 10
Table 3. Research Hypothesis Summary Table 30
Table 4. Relative Advantage Interview Summary Statistics 31
Table 5. Compatibility Interview Summary Statistics 32
Table 6. Leadership Attitude Toward Change Interview Summary Statistics 34
Table 7. Relative Frequency Summary of Negative Factors for Innovation 36
Table 8. Relative Frequency Summary of Positive Factors for Innovation 36
List of Figures

Figure 1. Researcher's Proposed Innovation Adoption Model 22

Figure 2. Data Analysis in Qualitative Research (Creswell, 2014, p. 197) 29
I. Introduction

Overview

Organizations change and evolve as society, technology, and other external factors exert influence over them. Many organizations are investigating possible benefits from adopting autonomous vehicles into their operations. Ostensibly, cars and trucks may not require input from their human passengers during transit, which may reshape the way whole industries conduct operations, and the way people transport themselves on a daily basis (Litman, 2014). As more people—and hence, organizations—tend towards using autonomous vehicles, many factors should be considered pertaining to organizational type, industry, sector structure, strategy, and so on in order to avoid unnecessary costs (Damanpour, 1991). These factors are examined in this research and used to gauge adoption readiness.

Organizations may be better prepared to adopt an innovation and avoid pitfalls by being aware of these factors and by adjusting to them. The United States Air Force (USAF) is no exception. The disruptiveness of autonomous vehicles as an innovation merits careful consideration for an organization with a large vehicle fleet mission. This research assesses vehicle fleet organizations’ readiness to adopt autonomous vehicles. The findings provide insight into factors affecting readiness to adopt autonomous vehicles, and outline considerations that the USAF may use moving further with adoption.

Definition of Key Terms

Innovation: Adoption of an internally-generated or purchased device, system, policy, program, process, product, or service that is new to the adopting organization (Damanpour, 1991).
**Innovation Diffusion:** The process by which an innovation spreads through a population of potential adopters (Wolfe, 1994).

**Autonomous Vehicles:** Ideally, an autonomous vehicle represents a mode of transport that will require no input from a human occupant during transit (Luettel, Himmelsbach, & Wuensche, 2012). An extremely disruptive upcoming innovation (Rosenzweig & Bartl, 2015).

**Background**

The world is experiencing an increased demand for autonomous vehicle features and is displaying a larger research and social media interest in the topic (Bartl, 2015). At present, many vehicles have standard features indicative of autonomous trends, including lane drift prevention, automatic braking, and so on; and the trend will continue. According to predictions, autonomous cars may be financially accessible to the middle class between 2040 and 2060 (Litman, 2014).

These implications also apply to the government and military. Several USAF and Department of Defense (DoD) functions require over-the-road (OTR) cargo and personnel movements. Many non-value-added labor hours are spent moving parts and tools, and those movements detract from labor that may have otherwise completed value-added tasks. Researchers have stated that autonomous vehicles will also have the benefit of working more efficiently, breaking less often and with less labor-related downtime, and having fewer accidents than their human-operated counterparts (Bartl, 2015; Luettel et al., 2012; Payre, Cestac, & Delhomme, 2014). All in all, the inevitable move to autonomous vehicles will improve the USAF’s functionality. Autonomous vehicles have been called the “next big disruptive innovation in the years to come;” however, that reality is still a long way away (Rosenzweig & Bartl, 2015). In the meantime, different organizations are in better positions to adopt this new innovation, and organizations within the USAF are no exception. Substantial commercial research exists on the
subject, as companies and governments work to stay with this trend. Many previous innovations, briefly discussed below, can be compared to autonomous vehicles vis-a-vis theories such as Diffusion of Innovation Theory (DOI) and the Theory of Planned Behavior (Ajzen, 1991; Wolfe, 1994).

Many vehicles available commercially have small-scale autonomous/automatic features (e.g., lane drift prevention, automatic parallel parking, and brake assist/collision prevention) and more comprehensive autonomous systems are being developed and tested. Autonomous vehicles will bring about many changes to OTR transportation. The USAF’s vehicle fleet will gradually reflect these innovations, albeit lagging behind the commercial sector. However, characteristics of some organizations indicate that they may be more receptive to adopt/diffuse this type of innovation.

The many considerations of adopting autonomous vehicles will have to be weighed against one another. In an USAF context, autonomous vehicles can have the cost-savings opportunities of: (1) eliminating excess labor in place for contingencies; (2) reducing required number of overall vehicle operators; (3) and increasing occupational safety, resulting in fewer injuries/deaths caused by human error (or deliberate, ambush-style attacks, in the case of military convoys). Just like every person in the United States, the USAF and the other branches of the DoD depend on vehicle movement in some way or another. Drivers transporting personnel and cargo are a large part of how the USAF executes its base-level and deployed operations. The USAF and DoD will not be exempt from the oncoming, increasing trend of autonomous vehicles. The USAF and DoD may reflect external trends as they have with previous innovations (Biggs, 2007; Byrd, 2003; Evans, 2006; Jacobs, 1988; White, 1991); in such circumstances, the USAF will become increasingly dependent on autonomous vehicles for operational needs.
Problem Statement

Autonomous vehicles will inevitably be adopted by large portions of society and many organizations. However, many innovation adoption factors are important, and an unprepared organization can waste significant sums of money by forcing an unwelcome or poorly executed change on its employees. On one such change, the USAF spent approximately $1.1 billion on a scrapped ERP system (Kanaracus, 2012). To prevent wasting taxpayer dollars, this research consists of case study and interview analysis of a USAF organization with a vehicle fleet mission.

The desired outcome of this research is a greater understanding of factors specifically relating to autonomous vehicles—as opposed to factors pertaining to other innovations in the extant literature—and a greater understanding of factors relating to USAF organizations that may affect innovation adoption. As discussed above, autonomous vehicles represent a disruptive innovation, and the findings from past studies using the same theories may not apply exactly as they do in their respective contexts. This research seeks to reconcile that disparity.

Research Questions

This research seeks to answer the following primary question and subsequent sub-questions:

RQ – What factors should be considered to determine if an organization is ready to adopt autonomous vehicles?

A. Do members of the USAF perceive a relative advantage toward adopting autonomous vehicles?
B. Do members of the USAF perceive autonomous vehicles as having a high level of compatibility with current values, beliefs, etc.?

C. Is there a sufficient training apparatus in place for the adoption of autonomous vehicles in the USAF?

D. Is there an appropriate leadership attitude toward change for the adoption of autonomous vehicles in the USAF?

E. Is there an appropriate level of accessibility in the USAF for the adoption of autonomous vehicles?

F. Does the USAF display appropriate levels of innovation effectiveness for the adoption of autonomous vehicles?

G. How might the bureaucratic nature of the USAF affect the adoption of autonomous vehicles?

Methodology

This research collects data using a single deductive case study method. The case study analyzes the 88th Logistics Readiness Squadron (88 LRS) at Wright-Patterson Air Force Base, Ohio. Data gathered include qualitative observations of 88 LRS workplaces, 88 LRS work-related meetings, the organization’s performance history (e.g., quarterly awards), enterprise-published best practices, organizational artifacts, and other observable phenomena. The interviews that also make up this case study focus on 88 LRS personnel in leadership positions in each flight, and are standardized using the same interview script. The case study and interview instruments are approved by AFIT’s Institutional Review Board (IRB). Equipment required to conduct this research is minimal; a personal cell phone to record interview responses and simple
note-taking methods are the means of gathering data. To analyze case study and interview data, qualitative content analysis methods ascribed to Creswell (2014) and Leedy and Ormrod (2013) are used. The content analysis will be discussed in detail during Chapter 4.

**Scope, Assumptions, and Limitations**

This research involves case study analysis of the 88 LRS. An LRS performs several functions that are currently being examined in the commercial sector for use of autonomous vehicles. For example, Vehicle Operations (VOps), executes many vehicle missions on bases that could be accomplished by autonomous vehicles. Also, in a deployed environment, vehicle operators and many Logistics Readiness Officers (LROs) are responsible for executing convoy missions through hazardous and/or hostile terrain.

The 88 LRS is located on Area A of Wright-Patterson AFB, OH. It is made up of military, civilian, and contract personnel. It is charged with a busy vehicle fleet mission, providing service to a geographically-separated installation with the Air Force Materiel Command (AFMC) Headquarters, many USAF technical schools and professional education programs, and a very busy day-to-day transport requirement. The unit also provides conventional LRS services to a Reserve mission on the flightline. Most LRSs have a military majority, whereas the 88 LRS is largely contracted. Despite this demographic dissimilarity, the implications of this research are assumed to have similar meaning because of past military experience of individual subjects, and because the 88 LRS is part of the overall USAF. These demographics are described in detail in Chapter 3.

Further, this research assumes that USAF vehicle fleet organizations display important behavioral characteristics of other, commercial organizations. The behavioral research from commercial vehicle fleet organizations is applicable to qualitative, behavioral analysis of USAF
units because 88 LRS personnel are incentivized similarly to their commercial counterparts. Therefore, research pertaining to behavioral analysis is applicable to individuals in the USAF. Last, the responses by individuals interviewed are assumed to be honest, full responses.

Finally, limitations to the research are multiple. Implications from this research should be extrapolated to units outside the scope of the study with caution. Bases, major commands (MAJCOMs), regions, and other entities outside the scope of this study may possess characteristics irreconcilable with those of the 88 LRS. Implications from this research may not apply to other branches of the military because of unique USAF characteristics. Also, autonomous vehicles constitute an ongoing, developing, and still-upcoming innovation. The implications of this study incorporate extant theory, and many newly-developed findings. However, future technical, procedural, or organizational changes may render this study’s findings less meaningful. Lastly, the implications from this research may not be applicable to civilian institutions because of the unique characteristics and mission sets of the 88 LRS, USAF, or military. The following chapter will review literature related to autonomous vehicles, acceptance of autonomous vehicles, and DOI.
II. Literature Review

Introduction

This section reviews the literature related to autonomous vehicles, acceptance of autonomous vehicles in the United States, and DOI theory. Next, innovations and their varying roles in different environments is discussed by examining the topic from the perspectives of several scholars. The previous research focuses on innovation and organizational factors, and an organization’s propensity to adopt an innovation. Lastly, hypotheses and the research model are presented.

This research uses Rogers’ (1995) DOI theory as a framework for innovation adoption decision-making. The literature is centered on public and private sector endeavors, and theory pertaining to those is posited to pertain to USAF organizations as well. Also, DOI analysis of organizations is well-documented. However, no studies have been performed in the USAF—in the context of organizational behavior or DOI theory—pertaining to autonomous vehicles. This research focuses on addressing that gap in the literature.

Overview of Autonomous Vehicles

Autonomous vehicles became a reality during a Carnegie Mellon University project in the 1980s, where the vehicles were given specific, structured environments to navigate. The progress since has yielded production cars with what are now common features such as lane departure warnings, lane keeping assist systems, and adaptive cruise control systems. More recently, advanced pre-crash warning and intervention systems have emerged to decrease damage by braking more quickly than a human can. The trend towards autonomy was augmented by the 2001 National Defense Authorization Act (NDAA), where Congress mandated increased employment of unmanned vehicles (Luettel et al., 2012). The 2001 NDAA is generally
associated with unmanned aerial vehicles, but its merit also applies to ground vehicles. Given sufficient technical and safety advancement, autonomous vehicles may take over roles currently held by air, water, or air based vehicles. This research is focused on ground-based vehicles, which itself encompass a vast array of roles.

**Cost/Benefit Analysis of Autonomous Vehicles**

Autonomous vehicles will greatly affect any environment or industry they enter, whether they are land-, sea-, or air-based. The changes would likely produce several different benefits and problems. As shown in Table 1, Litman (2014) described some of those likely benefits and problems.

**Table 1. Autonomous Vehicle Potential Benefits and Costs (Litman, 2014)**

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Costs/Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced driver stress. Allow motorists to rest and work while travelling.</td>
<td>Increases costs. Equipment, services and maintenance, and infrastructure.</td>
</tr>
<tr>
<td>Reduced driver costs. Taxis and commercial transport.</td>
<td>Additional risks. May introduce new risks.</td>
</tr>
<tr>
<td>Mobility for non-drivers.</td>
<td>Security and privacy concerns. Criminal and terrorist activities; information/tracking abuse.</td>
</tr>
<tr>
<td>Increased safety. May also decrease insurance costs.</td>
<td>Induced vehicle travel and increased external costs. Parking, crashes, pollution externalities.</td>
</tr>
<tr>
<td>Increased road capacity, reduced costs.</td>
<td>Social equity concerns.</td>
</tr>
<tr>
<td>More efficient parking, reduced costs.</td>
<td>Reduced employment and business activity.</td>
</tr>
<tr>
<td>Increase fuel efficiency and reduce pollution.</td>
<td>Misplaced planning emphasis. Decreased focus on other transport/community issues.</td>
</tr>
<tr>
<td>Supports shared vehicles.</td>
<td></td>
</tr>
</tbody>
</table>

The transition to fully autonomous vehicles will likely involve a tradeoff between these costs and benefits. It may come in the form of an incremental increase of the cost-benefit ratio, with respective increases in autonomy. The next section describes varying levels of vehicle autonomy.
Levels of Autonomy in Vehicles

Disruptive innovations, such as autonomous vehicles, do not emerge suddenly; but rather, they commonly develop incrementally. Obstacles to their adoption can include technological capabilities, preexisting laws, and social norms. Though vehicles have been developed with some autonomous features, full autonomy has yet to be realized. According to Litman (2014), four theoretical levels of autonomous vehicles exist, with increasing amounts of functional automation. For example, many Level 1 automations are present in automobiles today; simple cruise control is an example of a function-specific automation, and more modern cars contain features that may breach Level 2 (Litman, 2014). In Table 2. Levels of Autonomous Vehicles (Litman, 2014) below, each level is described:

Table 2. Levels of Autonomous Vehicles (Litman, 2014)

<table>
<thead>
<tr>
<th>Level Number</th>
<th>Automation Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Function-specific Automation</td>
<td>Automation of specific control functions, such as cruise control, lane guidance, and automated parallel parking. Drivers are fully engaged and responsible for overall vehicle control (hands on the steering wheel and foot on the pedal at all times).</td>
</tr>
<tr>
<td>Level 2</td>
<td>Combined Function Automation</td>
<td>Automation of multiple and integrated control functions, such as adaptive cruise control with lane centering. Drivers are responsible for monitoring the roadway and are expected to be available for control at all times, but under certain conditions can disengage from vehicle operations (hands off the steering wheel and foot off pedal simultaneously).</td>
</tr>
<tr>
<td>Level 3</td>
<td>Limited Self-Driving Automation</td>
<td>Drivers can cede all safety-critical functions under certain conditions and rely on the vehicle to monitor for changes in those conditions that will require transition back to driver control. Drivers are not expected to constantly monitor the roadway.</td>
</tr>
<tr>
<td>Level 4</td>
<td>Full Self-Driving Automation</td>
<td>Vehicles can perform all driving functions and monitor roadway conditions for an entire trip, and so may operate with occupants who cannot drive and without human occupants.</td>
</tr>
</tbody>
</table>

The levels of autonomy are not individually important, with the exception of Level 4. Fully autonomous vehicles are the object of this research; therefore, case study and interview methodologies are centered on Level 4 autonomous vehicles.
Diffusion of Innovation Theory

DOI seeks to define innovations in an organizational context, and how innovations are communicated throughout the organization (Rogers, 1995). It also posits factors that affect the propensity to adopt an innovation. In the following sections, DOI is described, varying definitions and types of innovation are reconciled, and other theories pertaining to group and individual behavior and innovation diffusion are described.

Theory

As defined by Rogers (1995), the major components of DOI are as follows:

1. Innovation: “An innovation is an idea, practice, or object that is perceived as new by an individual or another unit of adoption” (Rogers, 1995).

2. Communication Channels: “A communication channel is how messages get from one individual to another. The nature of the information-exchange relationship between a pair of individuals determines the conditions under which a source will or will not transmit the innovation to the receiver, and the effect of the transfer” (Rogers, 1995).

3. Time: “The time dimension is involved in diffusion (1) in the innovation-decision process by which an individual passes from first knowledge of an innovation through its adoption or rejection, (2) in the innovativeness of an individual or other unit of adoption, and (3) in an innovation’s rate of adoption in a system” (Rogers, 1995).

4. Social System: “A social system is a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems” (Rogers, 1995).

Furthermore, Rogers (1995) defines five factors that affect organizational diffusion of innovation, which are: (1) innovation factors; (2) individual factors; (3) task
factors; (4) environmental factors; and (5) organizational factors. Further, each factor is further decomposed into multiple sub-factors, which results in a model incorporating 28 total sub-factors (Rogers, 1995). These items are perceptional measures and are included in many innovation studies. In DOI studies, these traits represent independent variables and the dependent variable is the propensity to adopt an innovation (Rogers, 1995). This research uses six of these sub-factors for the basis of its investigation.

Innovation Defined

Many define innovation differently. For example, some research shows that innovation is typically stimulated by a “performance gap” between actual and desired results (Rogers, 1995), and that innovations are adopted to better increase organizational performance (Damanpour, 1991). Performance gaps may come in the form of performance relative to that of competitors, poor performance or missed opportunities in the marketplace, or unmet customer expectations (Evans, 2006). Innovations may also simply be something new to an organization; according to Damanpour’s meta-analysis, innovation is defined as “the adoption of an idea or behavior, whether a system, policy, program, device, process, product or service, that is new to the organization” (Byrd, 2003).

In Ravichandran’s (1999) study of administrative innovation adoption, he argues that Damanpour’s definition equates innovation with adoption synonymously. He also states “studying adoptions in the name of innovations will result in content fallacy and contextual fallacy” (Ravichandran, 1999). However, that is where this research returns to Rogers’s more simple and concise definition of innovation. His definition also succeeds in explaining the motivation for adopting an innovation insofar as the organizational performance gap. Although Damanpour’s and Rogers’ definitions vary slightly, the innovation (idea, process, product, or
practice) is perceived to be new according to the individual or adopting organization (Evans, 2006). For this research, autonomous vehicles will be viewed as an innovation using Rogers’ definition.

**Categories of Innovation**

An innovation may be categorized in single or multiple ways, and it is important to know what definition (or definitions) applies. The types of innovation affect the way the innovation may be diffused within an organization. Damanpour’s (1991) meta-analysis discusses types of innovation. He outlines three classification types, where an innovation represents either a product or process; either technical or administrative innovations; and either radical or incremental innovations (Damanpour, 1991). Innovations may also eclipse both subdivisions of those three classifications, and they are more disruptive if that is the case. Autonomous vehicles may one day merit classification as product, process, technical, and administrative innovations. Furthermore, they would be more radical than incremental. Autonomous vehicles, however, will also be implemented incrementally in a fashion akin to Litman’s (2014) four levels. These categories are important in framing the goals of this case study and its interview questions, and may serve to more accurately forecast adoption timelines and requirements in future research. Further discussion on these types of forecasts will be included in Chapter 5.

**Innovation Factors**

According to Rogers (1995), there are five factors of innovation adoption that are further decomposed into sub-factors. The first of these main categories of factors has to do with a given innovation. Per Tornatzky and Klein (2014, 1982), the relationship between innovation factors and propensity to adopt an innovation can be generalized. Their meta-analysis showed that out of the 25 innovation factors evaluated by prior studies, the following ten factors were most
frequently studied by researchers: (1) compatibility, (2) relative advantage, (3) complexity, (4) cost, (5) communicability, (6) divisibility, (7) profitability, (8) social approval, (9) trialability, and (10) observability. Of those ten innovation sub-factors, only three sub-factors—relative advantage, compatibility, and complexity—were consistently significant. Relative advantage and compatibility were positively correlated with innovation adoption and complexity is negatively correlated (Tornatzky & Klein, 1982; Weigel, Hazen, Cegielski, & Hall, 2014). Relative advantage is consistently found to be a key sub-factor in nearly all studies pertaining to the adoption of innovation (Evans, 2006).

The three sub-factors highlighted above are apt for this study, but only relative advantage and compatibility are factors assessed during this research, of those three. This choice is made because of the prevalence in relative advantage and compatibility as a factor in the literature, and their strong correlation with overall propensity to adopt a given innovation. Also, as discussed above, in the 2014 meta-analysis of diffusion factors in information systems, complexity did not generalize across all studies examined (Weigel et al., 2014). Complexity is not assessed in this research; future research about diffusion of autonomous vehicles may consider such analysis appropriate.

**Innovation Factor Hypotheses**

The literature demonstrates that relative advantage and compatibility are the two most correlative innovation factors in past research endeavors; therefore, they are appropriate to investigate propensity to adopt autonomous vehicles. Following are the first two research hypotheses.

**Hypothesis 1**—Perceived relative advantage is positively related to the propensity to adopt autonomous vehicles.
Hypothesis 2 – Compatibility is positively correlated with the adoption of autonomous vehicles.

Organizational Factors

In addition to factors pertaining to the innovation itself, it is also important to consider factors of the organization adopting that innovation. The organizational sub-factors that affect the decision to adopt an innovation are indeed very influential. In Damanpour’s meta-analysis, thirteen organizational sub-factors that have been empirically tested to affect innovation adoption – either positively or negatively (Damanpour, 1991). The ten positive organizational sub-factors are (1) specialization, (2) functional differentiation, (3) professionalism, (4) managerial attitude toward change (including top management support for the innovation), (5) managerial tenure, (6) technical knowledge resources, (7) administrative intensity, (8) slack resources, (9) external communication, and (10) internal communication. Damanpour found a negative association between innovation and centralization and non-significant associations between innovation and formalization, managerial tenure, and vertical differentiation (Damanpour, 1991). Using Damanpour’s (1991) work as a springboard, innovation literature has found leadership attitude toward change and internal communication-related factors as important in the successful adoption and diffusion of an innovation (Premkumar, G., Ramamurthy, K., & Nilakanta, 1994; Premkumar & Potter, 1995; Prescott & Conger, 1995; Ruppel & Howard, 1998; Russell & Hoag, 2004; Wilson & Ramamurthy, 1999). Further, several studies have indicated that a risk-promoting environment is positively correlated to innovation adoption (Aiman-smith, Goodrich, Roberts, & Scinta, 2005; Ravichandran, 1999; Wilson & Ramamurthy, 1999).

This research will focus on the four most prevalent organizational factors discussed in literature: the level of training, leadership attitude toward change, accessibility, and innovation
effectiveness within the 88 LRS. Similar studies of innovation diffusion, the findings of Damanpour’s (1991) meta-analysis, and the study of previous innovation diffusion studies in the USAF led to these four being selected (Byrd, 2003; Rogers, 1995).

**Organizational Factors Hypotheses**

The literature has demonstrated strong positive correlation between levels of training, leadership attitude toward change, accessibility, and innovation effectiveness and the propensity to adopt innovations. Those factors are, therefore, appropriate to investigate effects on propensity to adopt autonomous vehicles. Following are the next hypotheses in this research.

**Hypothesis 3** – *Increases in training quality are positively correlated to the propensity to adopt autonomous vehicles.*

**Hypothesis 4** – *Positive leadership attitude toward change is positively correlated to the propensity to adopt autonomous vehicles.*

**Hypothesis 5** – *Accessibility level is positively correlated with the propensity to adopt autonomous vehicles.*

**Hypothesis 6** – *Innovation effectiveness is positively correlated with the adoption of autonomous vehicles.*

**Environmental, Individual, and Task Factors**

Rogers’s (1995) DOI theory accounts for environmental, individual, and task factors that affect propensity to adopt an innovation; however, those factors are not examined in this research. Factors here are included because of the correlation strength in related literature, and relevance to autonomous vehicles. Future research might consider examining the link between these factors and propensity to innovate. Particular examples of future research are included in Chapter 5.
Determinants of Innovation Implementation

The implementation area of the diffusion model contains a lack of research, affecting its viability for autonomous vehicles. The model also examines acceptance and integration, but implementation is the first critical step of real change following an innovation. Increasingly, researchers single out the innovation implementation stage as the cause for many innovation failures, post-adoption (K. J. Klein & Sorra, 1996). According to Rogers, especially in authority-driven innovation decisions, the users’ ability to implement is seen as the key to the innovation’s success (Rogers, 1995). Klein and Sorra’s (1996) research takes Rogers’ singular model of innovation diffusion and offer a source-based and a user-based model. The source-based model assesses an innovation from the perspective of the innovation developer or creator. This model is similar to the first three adoption stages of Rogers’ model. The user-based model, on the other hand, focuses on the initial incorporation of an innovation within an organization (K. J. Klein & Sorra, 1996). The user-based model is similar to the implementation and confirmation stages of Rogers’ model. Therefore, the user-based model of Klein and Sorra’s (1996) work and will serve as an underlying perspective of this research.

Klein and Sorra’s (1996) research also focuses on innovations that require coordination among multiple organizational members to the benefit of the overall organization. This type of innovation affects many organizational members and, moreover, is implemented following adoption decisions made by senior leadership (K. J. Klein & Sorra, 1996). This type of innovation equates to innovations under Rogers’ (1995) authority adoption decision model and can be difficult to implement because of the separation between decision-makers and members tasked with implementation. This research categorically applies to authority adoption decisions in the AF.
Klein and Sorr address this complexity by focusing on the model’s known determinants of effective innovation implementation. They define implementation as transition time when targeted organizational members become ideally skillful, consistent, and committed in their use of an innovation (K. J. Klein & Sorra, 1996). Damanpour posits implementation “consists of all events and actions pertaining to modification in both, an innovation and an organization, initial utilization, and continued use of the innovation when it becomes a routine feature of the organization” (Damanpour, 1991, p. 562), which is consistent with this definition. In any event, a lack of effective implementation leads to decreased likelihood that an innovation will yield desired benefits to the adopting organization (K. J. Klein & Sorra, 1996). Furthermore, implementation effectiveness lies in the organizational level and reflects the combined consistency and quality of targeted users’ innovation use (K. J. Klein & Sorra, 1996). Also, implementation effectiveness is determined by the dual influence of an organization’s implementation climate and innovation compatibility (Byrd, 2003). Each of these implications also applies to the organizational setting of the USAF.

As a springboard from Tornatzky and Klein’s (1982) results, a separate meta-analysis was performed to validate the assumptions of DOI and the Theory of Planned Behavior as foundational theory in information systems research. That study found that the correlations between relative advantage and compatibility, and adoption propensity to be the highest amongst DOI criteria. Furthermore, the correlations generated by this meta-analysis were applicable to all studies included, with the exception of the factor complexity (Weigel et al., 2014). Because of complexity’s weaker correlation lesser applicability to this research, it is omitted from this particular research. Selected factors will be discussed further later in this chapter.
Implementation, in summary, is an extremely critical step in the diffusion of an innovation. Organizations may be well prepared to receive and disseminate a well-suited change to the way they perform operations. However, innovation effectiveness is dependent upon several determinants, but the later processes are beyond the scope of this research; adoption antecedents remain the focus of this investigation. The analysis focuses on the 88 LRS’s readiness to adopt autonomous vehicles, rather than steps in implementation or long-term sustainment. Forecasting and long-term planning is important in any successful organization, and the strategic awareness to plan for innovation implementation may indicate an organization’s readiness to adopt autonomous vehicles. Each of those is an important skill for an organization to successfully implement an innovation; therefore, any organization – including the 88 LRS – should be aware of these while assessing its own implementation determinants.

**Innovation in Bureaucracies**

Several researchers have uncovered important, unique characteristics of innovation diffusion in the context of a bureaucratic organizations (Byrd, 2003; R. Klein, 2002; Lloyd, 2000). These organizations tend to display a strong resistance to change, despite the need to innovate. Bureaucratic organizations are characterized by complex structures, numerous layers, as well as unique cultures and value systems. A bureaucracy is fundamentally designed to standardize its activities and processes to improve its efficiency; however, that also hinders innovation. Klein (2002) described government work in particular as risk-averse, and its innovative climate as rife with managers seeking consensus, rather than making efforts for either incremental or radical changes.

There are additional innovation diffusion considerations. Klein (2002) also described issues in bureaucratic organizations attempting to diffuse process innovation and revealed two
critical points: (1) any decision in a bureaucracy must go through multiple layers of scrutiny, and (2) individuals within bureaucratic organization are risk- and change-averse (R. Klein, 2002).

Klein and Sorra (1996) explored the effects of bureaucratic decision-making layers. Their findings indicated that differences in perceptions of an innovation at different levels of an organization can have positive or negative effects on the success of an innovation (K. J. Klein & Sorra, 1996). Damanpour (1991, 1996) studied the moderating effects of an organization’s structure on its propensity to innovate. Among others, complexity and size are two sub-factors found that show a moderating effect on innovation in organizations. In more bureaucratic organizations, the magnitude of these effects increased (Byrd, 2003; Damanpour, 1991, 1996).

This research’s methodology does not lend itself well to a comparative analysis, as it is a single case study. No characteristic, DOI factor or sub-factor is measured against that of another organization. Rather, the similarities between 88 LRS and other USAF organizations is the foundation from which the researcher draws meaningful conclusions. During this research, bureaucratic characteristics are considered, but they are not critical sub-factors of analysis. As in past literature, bureaucratic characteristics will likely hinder the adoption of autonomous vehicles; however, it would be up to future research to assess those effects and possible outcomes.

**Adoption Decision Model**

Many scholars posit that organizational innovation and change are processes rather than an instantaneous occurrence (Frambach & Schillewaert, 2002). They also argue that Rogers’ DOI model accounts for this. Rogers’ model contains five stages of the process: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation (Rogers, 1995). These
stages reflect incremental processes, just as Litman’s (2014) levels of vehicle autonomy reflect gradual increases in automated capability. Rogers defines each of those terms as follows:

**Knowledge**: When the decision-making unit learns of an innovation’s existence and gains some understanding of how it functions

**Persuasion**: When the decision-making unit forms a favorable or unfavorable attitude toward the innovation

**Decision**: When the decision-making unit engages in activities that lead to a choice to adopt or reject the innovation

**Implementation**: When the decision-making unit puts an innovation to use

**Confirmation**: When a decision-making unit seeks reinforcement of an innovation decision that has been made (Byrd, 2003; Rogers, 1995)

The process of adopting and diffusing the innovation of autonomous vehicles is viewed from the perspective of these stages. This research is a preliminary, exploratory effort, and will consider all five stages; however, only the first two stages (knowledge and persuasion) will be applicable because the decision stage is not the AF’s foreseeable future. Later stages in Rogers’s process merit further study in the future.

**Proposed Research Model**

The research model consolidates each of the six hypotheses, and depicts them in Figure 1. The figure also shows the hypothesized positive, correlative relationships each independent variable has on the dependent variable, the propensity to adopt autonomous vehicles.
Summary

This chapter reviewed the literature pertaining to autonomous vehicles; DOI and innovation; determinants of innovation implementation; factors of innovation, organizations, environment, individuals, and tasks; and innovation in bureaucracies. These topics provide the context for the research hypotheses, describing the relationship between selected factors from literature and the propensity to adopt autonomous vehicles in the USAF. Finally, the research hypotheses and research model were presented. The following chapter discusses the research methodology and data analysis methods.
III. Methodology

Overview

This section aims to begin answering the questions listed in Chapter 1. The primary research question is as follows:

*What factors should be considered to determine if an organization is ready to adopt autonomous vehicles?*

In congruence with the exploratory nature of this research, this methodology is concerned with maximizing depth and breadth of the investigation. Thus, a single case study approach is utilized. Case studies are better suited for analyses inherent in exploratory research of contemporary events; case studies also require no control of behavioral events, an implication further discussed below (Yin, 2014).

Population

The population under investigation in this research is the 88 LRS at Wright-Patterson Air Force Base, Ohio. The 88 LRS is comprised of DoD civilians, contracted personnel, Air Force enlisted personnel, and one commissioned USAF officer. 88 LRS is comprised of the following five flights: Fuels Management Flight, Deployment and Distribution Flight, Materiel Management Flight, Vehicle Maintenance Flight, and Special Maintenance Flight. The mission of 88th Air Base Wing, the parent organization, is “[to] strengthen our people and optimize partnerships to deliver world-class capabilities” (“88th Air Base Wing,” n.d.).

The traits of 88 LRS make it a good unit of study for this research. 88 LRS is an organization representative of other LRSs throughout the USAF because it shares common organizational elements, and its hierarchy is similar to other LRSs. Furthermore, the 88 LRS is
charged with a large vehicle fleet mission, spanning base transportation and flightline operations. Considerations due to unique characteristics are discussed in Chapter 4.

**Research Instrument Review**

This research is a single case study approach. The case study consists of gathering qualitative data at the 88 LRS itself. The proposed research model (Figure 1, Chapter 2) described the independent variables this study examines, and their correlation to propensity to innovate. This research seeks a deeper understanding of the 88 LRS through the use of interview techniques. One-on-one interviews with members of the 88 LRS yields further qualitative data. These data are assumed to complement, contradict, or otherwise support findings of the case study site observations. Variances are later determined, and are discussed in the analysis section.

**Data Collection**

For this study, the researcher uses a single case study approach method. The reason behind this decision is centered on the qualitative data created by each method, and the desire for a robust analysis. The case study is considered for its usefulness in covering organizational-level characteristics and the researcher’s ability to observe many tangible and intangible characteristics about the organization. These case study data qualitatively describe characteristics about the organization. One-on-one interviews provide more data and complement the qualitative observations from the case study. Interviews provide insight to the individual perceptions about the organization, allowing the researcher to characterize the perception of the organization and compare that to the observed state of the organization from the case study. Also, interviews are a means of aggregating data about individuals within the organization, such as people’s morale and stress levels.
Case study observations of the 88 LRS include the following: posted/visible artifacts, published documents, awards, best practices, meeting notes, and other data. These data are gathered in person by the researcher, and with the assistance of LRS personnel, flight chiefs, and the chief 88 LRS administrative assistant. Relevance to the case study is determined by the researcher. The text of these data is compiled and summarized, to be analyzed along with the summaries of interview responses. The methods of analysis are discussed further in Chapter 4.

Interviews are conducted with seven members of the 88 LRS. These individuals are supervisor-level members of the 88 LRS, equivalent to flight chiefs and above. Each interview is conducted using the same scripted questions and methods. Randomly generated numbers are assigned to each subject number, as a means of future contact while retaining confidentiality. Interview materials can be found in Appendix A. The interview responses are transcribed and aggregated by the researcher for summary and analysis. The methods of analysis are discussed further in Chapter 4.

These two datasets each have strengths and weaknesses, but complement each other. One of the strengths of this dataset is its ability to find disparity between individuals’ perception of the 88 LRS and the researcher’s observations about the organization. For example, disparity pertaining to incentivized programs and a lack of emphasis from management might indicate a mismatch in what the organization considers to be important. Disparity aside, however, if interview data confirmed the findings of the researcher, congruence is a signal that the state of the organization and people’s perception of it are aligned. This would provide insight to the true state of readiness to adopt, among other innovations, autonomous vehicles.

**Analysis**

As an exploratory study, a deductive case study methodology was developed. This case study uses qualitative data analysis tools developed by Creswell (2104) and Leedy and Ormond
These tools make up a thorough, iterative categorization of the raw data gathered and deductively distilling them into meaningful abstract themes aimed at supporting or refuting hypotheses and answering the research question (Creswell, 2014; Leedy & Ormrod, 2013). Further discussion about analysis and methodology is in Chapter 4.

Summary

This chapter described the population under investigation, its appropriateness for research such as this, and that it is a representative unit of study within the Air Force. This chapter discussed the sampling method, the case study instrument, and the interviews that make up the raw qualitative data. Next, data collection and analysis procedures are described. The following chapter discusses analysis procedures and the results of these analyses.
IV. Data Analysis and Results

Overview

The purpose of this chapter is to present information and data gathered during this research. The research hypotheses are presented one at a time and analyzed. Data gathered during the case study is presented to support or refute each hypothesis. The objective of this chapter is to provide pertinent details from the conclusions drawn in chapter 5 of this work.

Analysis and Interpretation

The exploratory nature of this research requires its data to be qualitative. This research uses qualitative data analysis tools developed by Creswell (2014) and by Leedy and Ormrod (2013). In general, the intent of analysis and interpretation is to make sense of text, images, and verbal data. As a qualitative study, analysis can proceed alongside further data-gathering (Creswell, 2014). During analysis, the researcher must also distill the data to exclude less meaningful information, and aggregate the data into a small number of themes (Creswell, 2014; Leedy & Ormrod, 2013). Qualitative data analysis requires judgement over statistical techniques and a great deal of the analysis involves examining, summarizing, and looking for common themes in the data. Assessing the research questions is based largely on summarized data. Conclusions and recommendations are then drawn based on those assessments. This chapter focuses solely on the methodology and analysis, while the following chapter will discuss results and conclusions.

Figure 2 summarizes the data analysis methods of qualitative research, per Creswell (2014). This process is iterative and repetitive; it is carried out many times to best distill data into meaningful themes. After data is gathered in raw form, similar major topics are organized and clustered together. Additional data is analyzed, and those clusters are further organized to
determine emergent themes and categories. The researcher looks for ways to reduce the total list of topics relating to one another, attempting to draw lines between categories to show interrelationships and other meaningful linkages. Once all data has been parsed by the researcher, the abbreviations and categories should be finalized and data in each category should be used to perform preliminary analyses. If meaningful information is not derived from these analyses, recoding of data may be necessary (Creswell, 2014; Leedy & Ormrod, 2013). Iterations and analyses are repeated until convergence is achieved and no new themes emerge from the data.
These themes and descriptions are then used to assess support for each research hypothesis. Aggregate themes are interpreted by the researcher, and are assessed using consistent criteria for evaluating qualitative research, listed as follows: (1) purposefulness, (2) explicitness of assumptions and biases, (3) rigor, (4) open-mindedness, (5) completeness, (6) coherence, (7) persuasiveness, (8) consensus, and (9) usefulness (Leedy & Ormrod, 2013). Levels of support for
each hypothesis are assigned based on themes relating to each hypothesis. The outcome of each research hypothesis, and the support found during this research can be found in chapter 4.

**Hypotheses Overview**

The hypotheses are discussed individually in this chapter. Table 3 below summarizes the support offered to each research hypothesis. Most research hypotheses are supported or somewhat supported. This is further substantiated in extant research presented in Chapter 2, the Literature Review.

**Table 3. Research Hypothesis Summary Table**

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Weak/No Support</th>
<th>Somewhat Supported</th>
<th>Strongly Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: Relative advantage</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>H2: Compatibility</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H3: Training</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>H4: Leadership attitude toward change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H5: Accessibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H6: Innovation effectiveness</td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hypothesis 1 Analysis – Relative Advantage**

Perceived relative advantage is found to be positively correlated with an USAF organization’s propensity to adopt autonomous vehicles; Hypothesis 1 is somewhat supported. The qualitative responses showed trepidation pertaining to what relative advantage autonomous vehicles brought to the USAF mission. Also, there are doubts about what incentive there might be for USAF personnel to adopt such an innovation. There is convergence on mission focus and customer needs; there is not enough evidence to show that autonomous vehicles could handle current LRS workloads.

Table 4 below provides summary statistics for Questions 2.3 and 2.4 of the interview portion of the case study. These questions are posed with Likert scale responses from
interviewees. In respective order, respondents rate the prevailing attitudes towards adoption of personal, commercial, USAF, and DoD autonomous vehicles. In Question 2.3, respondents rated from -5 to 5 (reflecting a very negative and very positive attitude, respectively) the prevailing attitudes for varying uses of autonomous vehicles. In Question 2.4, respondents rated from -5 to 5 (reflecting increasing levels of comfort) how they feel about autonomous privately owned vehicles (POV) and government owned vehicles (GOV), respectively. These figures meaningfully demonstrate the following findings: (1) perceived relative advantage is greater for autonomous vehicles in roles outside the USAF and DoD at the time of this research; and (2) perceived relative advantage of autonomous vehicles is greatest for those of commercial applications and organizations.

Table 4. Relative Advantage Interview Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>max</th>
<th>min</th>
<th>mean</th>
<th>median</th>
<th>mode</th>
<th>st dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>3</td>
<td>-2</td>
<td>1.29</td>
<td>2</td>
<td>2</td>
<td>1.70</td>
</tr>
<tr>
<td>b</td>
<td>4</td>
<td>-2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2.16</td>
</tr>
<tr>
<td>c</td>
<td>3</td>
<td>-2</td>
<td>0.43</td>
<td>0</td>
<td>0</td>
<td>1.62</td>
</tr>
<tr>
<td>d</td>
<td>2</td>
<td>-2</td>
<td>0.57</td>
<td>0</td>
<td>2</td>
<td>1.51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>max</th>
<th>min</th>
<th>mean</th>
<th>median</th>
<th>mode</th>
<th>st dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>5</td>
<td>-2</td>
<td>0.14</td>
<td>-1</td>
<td>-1</td>
<td>2.73</td>
</tr>
<tr>
<td>b</td>
<td>4</td>
<td>0</td>
<td>2.14</td>
<td>2</td>
<td>2</td>
<td>1.46</td>
</tr>
</tbody>
</table>

As indicated by the differences in mean and median values between 2.3c/2.3d and 2.3a/2.3b, there is a higher perceived relative advantage for autonomous vehicles in roles outside the USAF and DoD than that of other organizations. During interviews, respondents largely cite safety/security and unknown reliability, roles, and capabilities as areas of concern. Posted materials and documents within the 88 LRS corroborate this as a source of organizational focus; safety and security materials and information are the most publically-visible material in the organization.
Perceived relative advantage is shown to be a meaningful factor in an organization’s propensity to adopt autonomous vehicles. Table 4 above provides summary statistics pertaining to relative advantage factors. The difference in mean and median values between 2.4a and 2.4b meaningfully indicate the following: (1) less perceived relative advantage to adopt autonomous vehicles in the AF than in organizations outside the AF; and (2) greater perceived relative in adopting an autonomous GOV than an autonomous vehicle for personal use. During interviews, respondents commonly cite greater faith in safety/security safeguards in GOVs over POVs, bureaucratic organizational characteristics, resistance to change, lack of contracting/monetary incentive to adopt, and fear of job displacement as reasons for their ratings. 88 LRS staff meeting minutes and other case study findings did not provide consensus in the importance of relative advantage toward propensity to adopt autonomous vehicles apart from these findings.

**Hypothesis 2 Analysis – Compatibility**

Perceived compatibility is found to be a meaningful factor in an organization’s propensity to adopt autonomous vehicles; Hypothesis 2 is somewhat supported. Table 5 below provides summary statistics for Question 6.1 of the interview. Interviewees rated from -5 to 5 (on a Likert scale of increasing compatibility) how well they believed autonomous vehicles fit into the values of their organization. These figures meaningfully demonstrate the following findings: (1) perceived compatibility for autonomous vehicles is lowered by variable characteristics such as capabilities, roles, and reliability; (2) safety/security affects perceived compatibility; and (3) the need for strong change advocacy affects compatibility.

**Table 5. Compatibility Interview Summary Statistics**

<table>
<thead>
<tr>
<th></th>
<th>max</th>
<th>min</th>
<th>mean</th>
<th>median</th>
<th>mode</th>
<th>st dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>5</td>
<td>0</td>
<td>2.43</td>
<td>3</td>
<td>1</td>
<td>1.81</td>
</tr>
</tbody>
</table>
There is convergence in respondents’ reasons for and against compatibility with USAF and autonomous vehicles. First, ‘safety/security’ is another meaningful characteristic affecting compatibility responses. Second, ‘unknown reliability and roles’ are cited as characteristics against compatibility scores. Also, strong change advocacy reportedly heightens compatibility when leaders can enthusiastically frame the adoption of a new innovation.

**Hypothesis 3 Analysis – Training**

Training is shown to be a somewhat meaningful factor in an organization’s propensity to adopt autonomous vehicles; Hypothesis 3 is somewhat supported. The case study produced mixed characterizations of the training offered in the 88 LRS. Findings included: (1) a lack of any formal training, apart from annual administrative requirements, (2) mixed feelings towards and experiences with formal feedback mechanisms for training, (3) mixed feelings and experiences providing informal feedback to leaders, (4) strongly-incentivized optional training, resulting in high levels of participation, and (5) a prevailing resignation to training programs from higher headquarters, rather than unit-developed programs. Perception of training is found to be relatively weak and those resulting effects hindered propensity to adopt autonomous vehicles.

**Hypothesis 4 Analysis – Leadership Attitude Toward Change**

Perceived leadership attitude toward change is shown to be perhaps the most meaningful factor affecting an organization’s propensity to adopt autonomous vehicles in this case study; Hypothesis 4 is strongly supported. Table 6 below provides summary statistics for Questions 4.1, 4.2, and 4.4 of the interview. These questions ask interviewees to rate the supportiveness of organizational leadership towards the following scenarios: (4.1) implementation of any new practice, idea, or innovation; (4.2) implementation of autonomous vehicles; and (4.4) input given by interviewee in implementation planning. The questions are asked in Likert scale format, on a
scale from -5 to 5, in increasing levels of supportiveness from leadership. The figures in Table 6 demonstrate a few interesting findings: (1) perceived leadership attitude toward change is greatly affected by immediate supervisor/subordinate relationship; (2) perceived input to leadership a subordinate has with even the same leader can vary greatly depending on circumstances; and (3) leaders are not perceived to have a favorable attitude towards adopting autonomous vehicles at this time.

Table 6. Leadership Attitude Toward Change Interview Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>max</th>
<th>min</th>
<th>mean</th>
<th>median</th>
<th>mode</th>
<th>st dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>5</td>
<td>3</td>
<td>4.29</td>
<td>5</td>
<td>5</td>
<td>0.95</td>
</tr>
<tr>
<td>4.2</td>
<td>5</td>
<td>-4</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3.06</td>
</tr>
<tr>
<td>4.4</td>
<td>5</td>
<td>-2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.38</td>
</tr>
</tbody>
</table>

Other interview inputs created meaningful findings during this research. First, perceived leadership attitude toward change varies amongst individuals in leadership positions. At the time of this research, respondents overwhelmingly provided favorable impressions of leaders’ attitudes towards implementation of new innovations, citing past LRS Director (LRS/CL) acceptance of feedback and ideas. This finding reinforces the importance for strong change advocates in leadership positions in the AF. Second, there is a swath of reasons against leaders favoring the adoption of autonomous vehicles at this time – among them are: (1) lack of information pertaining to autonomous vehicles such as their capabilities and reliability; (2) regulations and directions from above as vehicles for change; (3) shortsighted preference for augmenting organizational manpower and resources over possible USAF cost savings; and (4) negative experiences with providing formal/informal feedback.

Hypothesis 5 Analysis – Accessibility

There is not enough evidence to support the hypothesis: perceived level of accessibility is positively correlated with an organization’s propensity to adopt autonomous vehicles;
Hypothesis 5 is not supported. Interview respondents paint a negative picture of USAF organizations’ accessibility levels. Overwhelmingly, respondents lack any example of past organizational exploration of prospective/upcoming innovations. On the whole, such changes at an organizational level are expected to come in the form of orders from higher headquarters, contract negotiations, or some other form outside the control of any member of the 88 LRS. This is especially true of interviewees’ impressions of autonomous vehicles; no individual or organizational research into the matter has been considered at the time of this research. More than one respondent confessed that this research is his/her first confrontation with the topic. There were no examples of organizational promotion of accessibility found in any squadron posted materials, documents, nor during its weekly staff meeting. The lack of evidence and consensus did not offer enough evidence to support Hypothesis 5.

**Hypothesis 6 Analysis – Innovation Effectiveness**

There is not enough evidence to support Hypothesis 6. An organization’s innovation effectiveness may be a meaningful factor in its propensity to adopt autonomous vehicles; however, there is not sufficient consensus to support this hypothesis. Convergence was demonstrated in the following themes: (1) respondents overwhelmingly exhibit preference for compliance with regulations, abiding by the status quo; (2) while that is an indication of strong innovation effectiveness, respondents expect direction – and hence, innovations – to be directed from above the LRS-level; (3) innovation is praised but not formally incentivized to subordinate flights (e.g., with quarterly or appraisal awards); (4) flights and squadron show tendency for reactive (rather than proactive) approaches to operational issues; (5) past examples of resistance to formally implemented innovations (e.g., Flex Fuel and E-85 vehicles).
Interviewees overwhelmingly indicated that they could foresee situations when an innovation is not used, even after formal implementation in the organization. This is also true of respondents’ view of autonomous vehicles. With the exception of safety/security reasons once more, there are no overlapping clusters of rationale. Furthermore, interviewees indicated that adoption of autonomous vehicles would represent an act of compliance, rather than commitment. Overwhelmingly, this study demonstrated autonomous vehicles (and other innovation adoptions for that matter) represent individuals’ resignation to following orders from above, feeling unable or disincentivized to innovate the organization from their level. Lastly, themes uncovered in staff meetings and from 88 LRS documents did not sway the consensus one way or the other.

List of Factors, Ranked in Order of Occurrences

During the research, several themes affecting propensity to adopt autonomous vehicles continued to emerge. Table 7 and 8 give frequency of negative and positive factors influencing propensity to innovate, in rank order of frequency observed during the case study. Each table gives the top recurring factors, omitting those factors of lesser relative frequency.

Table 7. Relative Frequency Summary of Negative Factors for Innovation

<table>
<thead>
<tr>
<th>Negative Factor</th>
<th>Frequency</th>
<th>Relative Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance to change</td>
<td>14</td>
<td>0.163</td>
</tr>
<tr>
<td>Unknown reliability</td>
<td>13</td>
<td>0.151</td>
</tr>
<tr>
<td>Security/safety</td>
<td>13</td>
<td>0.151</td>
</tr>
<tr>
<td>Unknown roles/capabilities</td>
<td>13</td>
<td>0.151</td>
</tr>
<tr>
<td>Displaced jobs</td>
<td>5</td>
<td>0.058</td>
</tr>
<tr>
<td>Unknown cost</td>
<td>5</td>
<td>0.058</td>
</tr>
<tr>
<td>Negative experiences with feedback apparatuses</td>
<td>5</td>
<td>0.058</td>
</tr>
</tbody>
</table>

Table 8. Relative Frequency Summary of Positive Factors for Innovation

<table>
<thead>
<tr>
<th>Positive Factor</th>
<th>Frequency</th>
<th>Relative Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past acceptance of feedback and/or ideas</td>
<td>8</td>
<td>0.211</td>
</tr>
<tr>
<td>Need for strong change advocacy</td>
<td>7</td>
<td>0.184</td>
</tr>
<tr>
<td>Positive perception of current leaders’ attitude</td>
<td>7</td>
<td>0.184</td>
</tr>
</tbody>
</table>
Towards innovation

| Individual is eager early adapter | 5 | 0.132 |

These factors provide a qualitative picture of the prevailing positive and negative factors affecting propensity to adopt autonomous vehicles, and other innovations. These themes are covered above, during the discussion of each hypothesis; but they nevertheless provide insight to qualitative themes emerging for and against adoption of autonomous vehicles in the USAF.

Summary

The purpose of this chapter was to describe data gathered during this research, subsequent analysis, and meaningful information derived from those analyses. Each research hypothesis was addressed. Data and analysis in this chapter is pertinent to conclusions drawn by the researcher in Chapter 5.
V. Conclusions and Recommendations

Overview

The focus of this research is to answer the following question: “What factors should be considered to determine if an organization is ready to adopt autonomous vehicles?” Because organizational innovation adoption studies in the USAF about autonomous vehicles, in the context of DOI, could not be found, this research attempted to address that gap in the literature. The previous chapters discuss pertinent literature, methodology, data, and analysis. This chapter discusses conclusions drawn from these data and analyses, gives recommendations based on these findings, caveats limitations to this case study, and provides recommendations for future related research.

Discussion

Chapter 4 describes analysis and results of this research. The methodology and literature upon which they are based are selected as the best way to investigate the research question and hypotheses. DOI provides the theoretical framework used in this research to assess overall propensity to adopt autonomous vehicles, and the selected sub-factors related to adoption (Rogers, 1995). Iterative qualitative data analysis procedures were used to examine the data and distill them into meaningful information, relatable to the factors from DOI. Once complete, support for each hypothesis is assessed and other findings are reported. There is some support for H1, H2, and H3; there is strong support for H4. This research did not support H5 and H6.

The most strongly-supported hypothesis in this research is about leadership attitude toward change. Among the factors selected for this research, it has the strongest link to propensity to adopt autonomous vehicles. In this case study, squadron leadership—especially the commander or commander-equivalent—was found to be a critical enabler for change and
innovation. As the leader of that organization, he/she sets a strategic tone and direction for flight commanders to implement in their workspaces. Data collected indicate that past commanders had negative attitudes toward innovation and change; those negative attitudes negatively affected the organization’s ability to change, improve, or accept feedback toward that goal. In short, this case study finds that the leader’s attitude toward change can make or break innovation adoption.

The newness and unknown characteristics surrounding autonomous vehicles currently hinder the propensity to adopt. This manifests itself in many forms during the case study. Chiefly, safety and security are top concerns of the organization and of individuals interviewed. Threat of injury or death due to autonomous vehicles is unknown; the reliability of autonomous vehicles is unknown; their digital security is unknown; their roles and capabilities are unknown; and whether they can meet the needs of LRS customers is unknown. This may represent viable future research, which is discussed further along this chapter.

Current models of change and diffusion of innovation in the AF are directed, and the model is perceived to flow top-down. The case study found overwhelmingly that compliance with rules and regulations was the preferred method of operations. Any changes to the 88 LRS is expected to come from well above the squadron level, and interview respondents indicated that individuals in other LRSs likely feel the same way. Individuals in the 88 LRS indicated that they would not push for large-scale changes to their day-to-day operations because they are not incentivized to do so. Furthermore, contracts dictate the majority of operational procedures in the 88 LRS, and managers oppose the cost increases commonly associated with contract modifications. In interviews, the phrase “we take orders” emerged multiple times, indicating a tendency towards—and resignation to—military and bureaucratic organizational characteristics.
Recommendations

Recommendations of this research pertain to the promotion of innovation adoption, and the promotion of adopting autonomous vehicles. The first recommendations this section will discuss possible improvements to general propensity to adopt, not solely autonomous vehicles.

Among the factors studied in this research, leadership attitude toward change was the most strongly supported factor in the research model. These findings indicate that an LRS requires leaders and managers that function well as change advocates. If the USAF can capture an individual’s competence for change advocacy in an annual appraisal or performance report, and then promote that individual ahead of his/her peers. Alternatively, squadron command-equivalent positions might receive training to increase their individual attitude toward change. Either may result in a USAF with leaders better equipped to diffuse innovation and change.

Many ground-level, tactical decisions are restricted by contracts. The 88 LRS has no flexibility to modify those contracts and cannot deviate from related policy. If the USAF can levy greater flexibility to renegotiate contracts, it may result in cost savings. During this case study, interviewees discussed their inability to affect large-scale changes to operations, even if they knew it would improve efficiencies. By allowing mutually-beneficial contract modifications, the USAF would afford LRSs the chance to find better ways of doing business, and could disseminate those changes to other organizations.

There is currently little incentive for employees (active duty, civilian, and contractor alike) to push for innovations whatsoever. Individuals assume that changes will be diffused from above to other, similar organizations and feel powerless to improve many strategic working conditions for themselves. Currently, employees might receive recognition on annual appraisals, performance reports, or awards submissions; however, those incentives are relatively weak and
tend to lag behind any initiative shown in the writing of those packages. One possible change is to bring back the USAF’s Innovative Development through Employee Awareness (IDEA) Program—or something like it—which gave cash awards to government employees and active duty military personnel for cost savings innovations. The current program, Airmen Powered by Innovation (API), pools innovative ideas, but offers no other incentive to Airmen to submit creative ideas (“Air Force Launches New Program to Capture Innovative Ideas,” 2014). If API added those tangible incentives from IDEA, it would incentivize creative input and cost savings once again.

This research has also generated recommendations specific to the adoption of autonomous vehicles. The above recommendations also apply, most notably the need for leaders that function as effective change advocates because this research pertained to adopting autonomous vehicles in particular.

The USAF should improve perceived observability—one of the factors of DOI—of autonomous vehicles to increase propensity to adopt. Although it is not studied in this case study, implications of observability occur in multiple interviews. The relationship between observability and propensity to innovate, however, is not a finding of this research and studying it as a factor warrants further research. One possible way to improve observability of autonomous vehicles is to offer Airmen demonstration rides when they arrive. By experiencing an autonomous vehicle firsthand, many fears may be assuaged.

Limitations of the Research

There are several research limitations that should be considered. First, there are limitations with the researcher functioning as the observer. The researcher is subject to human error and may not always know what the most important things to look for is. This might result
in spending time observing and recording trivialities. The researcher’s own presence may influence what people say/do where they are performing a study. It may also generate different observational results. Written notes have their limitations, and the audio recordings of the interviews do not capture the whole of the interactions between the researcher and the interviewee; the act of recording may also make some uncomfortable or alter the way in which they respond.

Another set of limitations pertains to the unit and individuals subject to the interview and case study. This research assumes honest and complete responses to all questions asked during interviews and forthcoming with requested documents and materials. Interview materials are provided to interviewees beforehand so that they might have the opportunity to fully develop responses.

The intent of this research is to begin the discussion about what it takes to be ready to adopt autonomous vehicles in the USAF. As autonomous vehicles are yet developing technologically, the conversation and sentiment about them will continue to evolve. The researcher hopes that this study’s findings will serve as a starting point for future research pertaining to diffusion of innovation and diffusion of autonomous vehicles in the USAF. Several of these potential topics will be presented in the following section.

**Recommendations for Future Research**

This study broached the idea of diffusing autonomous vehicles as an organizational innovation. There is substantial extant literature pertaining to other innovations, making use of DOI theory over its many iterations. Autonomous vehicles, however, are a developing innovation at the time of this research, not fully mature, marketed, tested, legal, or otherwise
accessible in mainstream society. Future study of a similar nature may produce different results because of ongoing development and diffusion of autonomous features in vehicles.

Further investigation into related matters is also merited. First, autonomous vehicles as an organizational diffusion are studied in the context of only one USAF unit in this research, and the implications therein may not be applicable to other USAF units. The implications are even less applicable to organizations outside the USAF, and perhaps not applicable whatsoever to organizations not in the DoD. Additional research might be performed in organizations with different mission sets, characteristics, demographic makeup, regions or major commands, branches of the military, or organizations otherwise unlike the 88 LRS. Such research could reveal more specific, better-established characteristics of organizations suited for adoption of autonomous vehicles.

Also, because this research broached autonomous vehicles in a general sense, further studies into more specific roles for an autonomous vehicle will become necessary. For example, autonomous vehicles could ostensibly be used for personnel movement (such as with a base taxi service) or for cargo, parts, or fuel delivery (such as with a truck on the flightline). The data gathered in this research did not distinguish between possible roles of autonomous vehicles; but rather, autonomous ground vehicles as a general innovation are the subject of consideration. Further research might select one of these roles and investigate factors and sub-factors that distinguish that type of autonomous vehicle from others. Such research could reveal better locations or roles where autonomous vehicles are better suited in the USAF.

This research considered fully autonomous vehicles, but other studies might distinguish between different levels of autonomy using Litman’s (2014) four levels. It is possible that some automated features in vehicles generate different results along DOI factors than do other features.
Future research might uncover varying types or levels of autonomy that compel diffusion to happen more easily.

Lastly, this research selected the most correlative and relevant factors for autonomous vehicles within DOI, but other factors warrant examination. Future research should examine the other innovation and organizational factors and sub-factors. Among those sub-factors is observability. According to DOI, observability is an important innovation factor (K. J. Klein & Sorra, 1996; Rogers, 1995; Tornatzky & Klein, 1982; Weigel et al., 2014). Although observability is not studied in this case study, its prevalence in these findings certainly merit further investigation in future research. Future research is discussed further in this chapter.

Future research should also examine environmental, individual, and task factors related to the propensity to adopt autonomous vehicles. Additionally, Azjen’s Theory of Planned Behavior offers another perspective of how an organization might diffuse an innovation, not included in this research; future study may uncover findings pertinent to innovation diffusion along that or other theories. Although literature has provided this research with a starting point to investigate propensity to adopt, more diverse study may uncover other important, correlative factors. Analysts may be able to forecast implementation timelines of autonomous vehicles in the USAF, using past innovations’ timelines and knowledge of these innovation factors.
Appendix A – Interview Materials (Consent Form, Interview Script)

CONSENT TO PARTICIPATE IN CASE STUDY INTERVIEW

CASE STUDY OF AUTONOMOUS VEHICLE INNOVATION DIFFUSION IN 88 LRS

You have been asked to participate in a research study conducted by researchers from the Air Force Institute of Technology (AFIT), Graduate School of Engineering and Management, Department of Operational Sciences. The purpose of this study is to assess AF organizations’ readiness to adopt autonomous vehicles as an emerging innovation. The results of this study will enable the Air Force to optimally adopt autonomous vehicles, by comparing current-state organizational characteristics to deterministic antecedents found in organizational innovation diffusion research. I believe these results can directly save the Air Force wasted spending by optimally diffusing autonomous vehicles into organizations. You were selected as a possible participant and interview subject because of your current position in the 88 LRS, professional experience, and ability to provide input beneficial to this case study. Please read the information below and do not participate in this interview if you do not feel comfortable with any of the information or questions at any time.

- This interview is voluntary.
- You will not be compensated for participating in this study.
- Your answers and information will be kept confidential.
- Data collection for this project will be completed by the Fall of 2016. All responses will be stored in a secure work space until 1 year after that date. The responses will then be destroyed.

Please contact Maj Hazen with any questions or concerns at benjamin.hazen@afit.edu or 937-255-3636 x4337.

If you understand the procedures and above information and have no questions or concerns, please check the box marking your consent then continue. Thank you.

Subject Number

__________________________
Introduction

Good morning/afternoon. My name is Captain John Atkinson, and I'm a Masters of Logistics Management student from the Air Force Institute of Technology (AFIT) conducting a case study of the 88th LRS. My academic advisor is Major Benjamin Hazen, PhD. This case study is about organizational readiness and diffusion of innovation, and I believe it can save the Air Force money in the years to come during the adoption of self-driving vehicles. I've selected you as an interview subject because of your position in the LRS, professional experience, and ability to provide beneficial input. Your participation is anonymous and voluntary; in my analysis, you'll be identified only by your subject number, which is generated randomly; you can opt out at any point during the interview, or request that your input not be counted after the fact. All responses and information are kept confidential and will be kept secure for 1 year after completion of the study, at which point all responses will be destroyed. Please take a moment to read this consent form, which is yours to keep, and note the contact information in case you have any concerns.

Section 1 – Demographics & Intro

1.1 Today’s Date

1.2 Subject Number

1.3 Official Duty Title/Position

1.4 Rank/Grade, if Applicable

1.5 Brief job history; how'd you get where you are today?

1.6 Briefly describe role/responsibilities

Section 2 – Relative Advantage/Incentive

2.1 From a USAF perspective, can you think of any factors that would affect your unit’s likelihood of adopting autonomous vehicles?

2.2 From your organization’s perspective, can you think of any factors that would affect your unit’s likelihood of adopting autonomous vehicles?

2.3 How would you characterize the prevailing attitudes toward the following uses for autonomous vehicles?

<table>
<thead>
<tr>
<th></th>
<th>Very negative</th>
<th>Neutral</th>
<th>Very Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal</td>
<td>-5  -4  -3</td>
<td>-2</td>
<td>-1  0  1  2  3  4  5</td>
</tr>
<tr>
<td>Commercial</td>
<td>-5  -4  -3</td>
<td>-2</td>
<td>-1  0  1  2  3  4  5</td>
</tr>
</tbody>
</table>
2.4 How comfortable are you with the idea of using fully autonomous vehicles for personal conveyance in the following vehicle types?

<table>
<thead>
<tr>
<th></th>
<th>Extremely Uncomfortable</th>
<th>Neutral</th>
<th>Perfectly Comfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personally Owned Vehicle</td>
<td>-5  -4  -3  -2  -1   0  1  2  3  4  5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government Owned Vehicle</td>
<td>-5  -4  -3  -2  -1   0  1  2  3  4  5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section 3 – Training

3.1 Does your organization/flight/section have a formal training program (to include section orientation, OJT, professional progression, etc.)? If so, what do they look like?

3.2 Are there mechanisms to provide feedback to training program owners after training?

Section 4 – Leadership Attitude Toward Change

4.1 On the scale below, how do you characterize your leadership’s/supervisors’ overall attitude towards implementation of new practices, ideas, and innovations?

<table>
<thead>
<tr>
<th>Not supportive at all</th>
<th>Neutral</th>
<th>Completely supportive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leader attitude</td>
<td>-5 -4 -3 -2 -1 0 1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

4.2 On the same scale, how do you think they would feel about implementation of fully autonomous vehicles?

<table>
<thead>
<tr>
<th>Not supportive at all</th>
<th>Neutral</th>
<th>Completely supportive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leader attitude</td>
<td>-5 -4 -3 -2 -1 0 1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

4.3 Can you provide specific examples of how leadership has exhibited these attitudes?

4.4 How would you rate/describe the level of input to leadership you (and other individuals) have in implementation planning?
Not supportive at all  Neutral  Completely supportive

Impact from input

-5 -4 -3 -2 -1 0 1 2 3 4 5

- [If high (4-5)] How would you describe the importance of your input on implementation of autonomous vehicles?

- [If low (1-3)] Do you think more actively seeking input would improve implementation of something like autonomous vehicles? What could leadership do/change to facilitate better implementation efforts from employees?

Section 5 – Accessibility

5.1 Has your squadron/flight/section sought better information (from magazines, books, web, trade info, etc.), for better information about some new/prospective innovation?

5.2 Has your organization ever sought such material pertaining to autonomous vehicles?

Section 6 – Values Fit

6.1 How would you rate the compatibility of autonomous vehicles with your organization’s beliefs and culture (on what scale)?

Completely Incompatible  Neutral  Completely Compatible

-5 -4 -3 -2 -1 0 1 2 3 4 5

6.2 In your opinion, what (if any) would be the major cultural compatibility issue(s) transitioning to autonomous vehicles? Describe how this might hinder adoption.

Section 7 – Innovation Effectiveness

7.1 Do you feel there might be situations where autonomous vehicles aren’t used, even after they are implemented? If so, please describe them.

7.2 For this question, imagine that your organization has the opportunity to become the AF’s first logistics unit using autonomous ground vehicles to perform core mission tasks. I will first read two definitions and I would like you to indicate which category you think your attitude would be concerning autonomous vehicles, given current organizational environment

Compliance: The use of an innovation comes primarily from leadership.

Commitment: Use of innovation comes from the alignment of the innovation with the values and beliefs of an organization and its use stems from a genuine enthusiasm about the innovation.
Section 8 – Respondent Comments

8.1 Finally, is there anything you feel is important to add? You can go over topics we’ve discussed or anything you feel is related.

Conclusion

Do you mind if I contact you using your work email address if I have any questions or want to clarify any responses?

Thank you very much for taking time out of your day for this interview. Once more, the sheet I’ve given you has contact info if you have any questions or concerns.
MEMORANDUM FOR AFIT IRB Reviewer

FROM: AFIT/ENS
2950 Hobson Way
Wright Patterson AFB OH 45433-7765

SUBJECT: Request for exemption from human experimentation requirements (32 CFR 219, DoDD 3216.2 and AFI 40-402) for distribution of Diffusion of Autonomous Vehicles Organizational Innovation Case Study.

1. The purpose of this study is to assess AF organizations’ readiness to adopt autonomous vehicles as an emerging innovation. The results of this study will enable the Air Force to optimally adopt autonomous vehicles, by comparing current-state organizational characteristics to deterministic antecedents found in organizational innovation diffusion research.

2. This request is based on the Code of Federal Regulations, title 32, part 219, section 101, paragraph (b) (2) Research activities that involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior unless: (i) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) Any disclosure of the human subjects’ responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects’ financial standing, employability, or reputation.

3. Methodology to mitigate personal identifiers/demographic information.

   a) The data collected from the case study and interviews will be recorded without any names or personal data and stored in a password protected database. Any reference to the information collected from the subjects in any published document will exclude personal identifiers and will only be referenced by the associated survey number randomly assigned to each survey response.

   b) I understand that if personal identifiers or data are collected it must be protected at all times, only be known by the researcher, and managed according to the AFIT interview protocol. All interview data will only be handled by the principal investigator. At the conclusion of the study, all data will be retained and protected by the principal investigator.

4. The following information is provided to show cause for such an exemption:
a) Equipment and facilities: Case study data will be gathered on-site at 88 LRS places of work. Data gathered will not contain personally identifiable remarks. Interview data will be subject to CFR precautions concerning anonymity, following informed consent.

b) Subjects: Individuals chosen to be interviewed will be squadron leadership representatives, flight commander-equivalent GS/contracted employees of the 88 LRS, and other supervisory representatives as deemed appropriate by the researcher.
   - Source of subjects – 88 LRS leadership representatives, flight commander-equivalent representatives, flight chief-equivalent representatives; other interviewees subject to availability and relevance to study.
   - Total number of subjects: Between 8 and 20.
   - Inclusion criteria: Individuals with organizational positions/experience to offer perspective on 88 LRS

c) Timeframe: Case study data gathering and interviews will take place during Fall/Winter 2016 and into early 2017 (if necessary). Application for a Survey Control Number will commence upon receiving appropriate IRB approval for the research.

d) Data collected: Primarily, research is a case study. Qualitative data are gathered at the 88 LRS pertaining to organizational behavior. No personally identifiable data are gathered through case study observations. Additionally, interviews of some members of the 88 LRS will be administered.
   i. Case Study Research: qualitative data; organizational characteristics, documents, meeting content, artifacts, posted material, etc.; researcher’s observations (Attachment 5).
   ii. Interviews: demographic questions; perception of organizational innovativeness and other characteristics; perception of autonomous vehicle compatibility with 88 LRS, USAF, etc.; respondent comments (Attachment 6).

e) Risks to Subjects: Minimal. Any disclosure of the human subjects’ responses outside the research will not place the subjects at risk of criminal or civil liability or be damaging to the subjects’ financial standing, employability, or reputation.

f) Informed consent: All subjects are self-selected to volunteer to participate in the interviews. No adverse action is taken against those who choose not to participate. Subjects are made aware of the nature and purpose of the research, sponsors of the research, and disposition of the interview results. This will be communicated to the subjects in a consent form, which will require their acceptance prior to the interview becoming accessible to the subject. (Attachment 5).

5. If you have any questions about this request, please contact Maj Benjamin Hazen (principal investigator) – Phone 785-3636, ext. 4337; E-mail – benjamin.hazen@afit.edu.

BENJAMIN T. HAZEN, Maj, USAF
Principal Investigator
Appendix C – Quad Chart

**Diffusion of Autonomous Vehicles as an Organizational Innovation**

**Introduction**
All organizations incur costs during the adoption and diffusion of new innovations. Adoption can fail, or organizations can incur excessive costs if diffusion is executed poorly. Diffusion of innovation is a long-standing field of research, but autonomous vehicles present a rarely-seen level of disruptiveness to commercial/governmental organizations and to societal norms. This merits scrutiny of organizations with large vehicle fleets, such as the USAF. Findings of this research can be used to better understand USAF readiness to adopt autonomous vehicles.

**Research Goals**

**Primary Research Question:** What factors should be considered to determine if an organization is ready to adopt autonomous vehicles?
- Relative advantage?
- Compatibility?
- Training?
- Leadership attitude toward change?
- Accessibility?
- Innovation effectiveness?

**Research Model**

**Methodology**
This research conducted a single case study of the 88th Logistics Readiness Squadron, Wright-Patterson AFB, OH. Qualitative data gathered includes structured interviews, posted/visible artifacts, published documents, award submissions, awards won, best practices, meeting notes, and other data. All data gathered aimed at addressing research questions. Tools from Creswell (2014) and Leedy & Ormond (2013) were applied for analysis and interpretation.

**Implications**
There was strong support for leadership attitude toward change being linked to autonomous vehicle adoption. There was some support for relative advantage, compatibility, and training being linked to adopting autonomous vehicles.

**Conclusions & Recommendations**
1. Squadron commanders must be change advocates. Either promote these types of individuals ahead of their peers, or offer change advocacy training prior to their assuming command.
2. Contracts and organizational inertia restrict innovation diffusion at the tactical level. Make large-scale changes easier to diffuse from the squadron level.
3. Offer monetary compensation for innovative, cost-saving ideas generated by individuals.
4. Improve perceived observability of autonomous vehicles before attempting to implement.

**Hypotheses: Correlation to Propensity to Adopt Autonomous Vehicles**

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<thead>
<tr>
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<th>Relative advantage (+)</th>
<th>Compatibility (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational Characteristics:</td>
<td>Training (+)</td>
<td>Leadership attitude toward change (+)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Propensity to Adopt Autonomous Vehicles</th>
<th>Weak/No Support</th>
<th>Somewhat Supported</th>
<th>Strongly Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative advantage</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compatibility</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Leadership attitude toward change</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accessibility</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Innovation effectiveness</td>
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**Researcher:**
Capt John D. Atkinson IV
Advisor: Maj Benjamin Hazen, PhD
Logistics and Supply Chain Management (ENS)
Air Force Institute of Technology
Bibliography


Tornatzky, L. G., & Klein, K. J. (1982). Innovation Characteristics and Innovation Adoption-


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5e. TASK NUMBER
5f. WORK UNIT NUMBER

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14. ABSTRACT

All organizations incur costs during the adoption and diffusion of new innovations. Adoption can fail, or organizations can incur excessive costs if diffusion is executed poorly. Diffusion of innovation is a long-standing field of research, but autonomous vehicles present a rarely-seen level of disruptiveness to commercial and governmental organizations and to societal norms. This merits scrutiny of organizations with large vehicle fleets, such as the USAF. The findings of this research assess USAF readiness to adopt autonomous vehicles along extant factors from literature.

15. SUBJECT TERMS

Diffusion of Innovation Theory, Autonomous Vehicles

16. SECURITY CLASSIFICATION OF:

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Maj. Benjamin T. Hazen, AFIT/ENS

19b. TELEPHONE NUMBER (Include area code)

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56