MITIGATING POTENTIAL LONE WOLF TERRORIST ATTACKS AGAINST AVIATION SECTOR INFRASTRUCTURE

by

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Abstract

This thesis proposes two primary concepts: (1) that the effective degradation of terrorist organizations by the U.S. and allied nations has contributed to the proliferation of lone wolf terrorism, and (2) that the greatest vulnerability to lone wolf terrorism is critical infrastructure, with the aviation sector being the most desirable target. To determine the validity of these concepts, this thesis analyzes existing literature pertaining to terrorist behavior, causes of radicalization, and common attack modalities, and then introduces statistical and quantitative data to determine if lone wolf terrorists display a proclivity towards targeting specific locations.

Data reveals that domestic lone wolf terrorism is increasing both in frequency and lethality. This is partially attributable to propaganda that concentrates on recruiting and inspiring lone wolf terrorists and encourages them to develop plots and self-mobilize. An assessment of established terrorist target selection criteria indicates that the aviation sector represents a highly desirable target relative to other critical infrastructure targets. An analysis of common lone wolf terrorist attack modalities indicates that firearms and explosives are the most frequently used weaponry, and that the aviation sector, specifically airports, are vulnerable to such attack modalities.

Various security measures can be implemented to mitigate potential terrorist attacks. These measures include: (1) physical security measures, (2) preemptive investigatory processes, and (3) preventive de-radicalization programs. Physical security measures can be incorporated into the design of airports and include physical barriers, blast-resistant materials, and ballistic glass, all of which reduce the potential for injury during an attack but can be costly and sometimes aesthetically displeasing. Law
enforcement officials conduct explosive detection investigations using a combination of machine detection devices and animal detection. Both methods have proven effective in detecting common energetic materials but also have inherent limitations that reduce their utility. Counter-radicalization programs proactively mitigate root causes that lead to violent radicalization. Such programs have yielded mixed results and have been wrought with controversy stemming from accusations of racial bias. Ultimately, a combination of these mitigation techniques has the potential to reduce the threat that lone wolf terrorism poses to the aviation sector.

Thesis advisor Professor Adam Wolfson. Reviewed by Professors Elena Mastors, Anthony Lang, and Dorothea Wolfson.
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Introduction

A singular, catastrophic event has personified the previously opaque yet foreboding threat that is terrorism. This event has fundamentally influenced politicians, military leadership and the intelligence community so profoundly that much of the current counter-terrorism policy is predicated on it. The reaction to 9/11 is understandable, as it is the single deadliest terrorist attack to occur in the United States.¹ The cost in terms of human casualties, capital resource loss, and the disruption to normal social functions, resulting from elevated levels of fear, cannot be understated. This event affected not just U.S. but global politics as a whole. Most reasonable state actors have deemed it a necessity to degrade terrorist organizations’ offensive capabilities to the extent that they lack the capacity to conduct comparable or even more destructive operations. Yet, despite these efforts, the threat posed by terrorism still looms. This raises the question, is it possible to prevent terrorism?

The war against terrorism is constantly evolving. The U.S. and allied nations have dedicated tremendous resources financially and in terms of military personnel and equipment to degrade or eliminate the ability of terrorist organizations to execute plots. The war on terrorism has coincided with the increase of homegrown terrorism, specifically lone wolf terrorism, which is defined in this thesis as the threat or use of violence by a single perpetrator (or small cell), not acting out of personal material reasons, with the aim of influencing a wider audience, and who acts without any direct support in the planning, preparation, and execution of the attack, and whose decision to

¹ National Consortium for the Study of Terrorism and Responses to Terrorism, “START.” Global Terrorism Database, 2016, Retrieved from https://www.start.umd.edu/gtd
act is not directed by any group or other individuals (although possibly inspired by others). This metamorphosis indicates that counterterrorism policy and methodology must rapidly evolve to address the threat. While it is impractical to suggest that all terrorist attacks can be detected and prevented, careful analysis of terrorist behavioral patterns, targeting preferences and attack modalities can help security officials develop more effective predictive models and mitigation technologies and policies.

**Methodology**

Instances of lone wolf terrorism are proliferating and corresponding mitigation technologies and policies are required to protect the citizenry; thus it is imperative to answer two essential questions: (1) what locations will become the preferred targets for lone wolf terrorists, and (2) what are the most likely attack modalities used by lone wolf terrorists? To answer these questions, this thesis analyzes existing literature pertaining to terrorist behavior, causes of radicalization, and common attack modalities and then introduces statistical and quantitative data to determine if lone wolf terrorists display a proclivity towards targeting specific locations. In order to accomplish this goal, target selection criteria will be identified to better understand what factors take precedence in the selection process.

This thesis proposes two primary concepts: (1) that the effective degradation of terrorist organizations by the U.S. and allied nations has contributed to the proliferation of lone wolf terrorism, and (2) that the greatest vulnerability to lone wolf terrorism is critical infrastructure, with the aviation sector being the most desirable target. Analysis of the results will be utilized to develop detection, mitigation, and prevention techniques with the ultimate goal of deterring attacks and saving lives.
Framework

This thesis consists of three chapters:

**Chapter I:**

Chapter one proposes that concerted military efforts by the United States and other nations have significantly degraded the offensive capacity of prominent terrorist organizations. In response to their diminished power, terrorist organizations have used propaganda efforts to radicalize sympathetic individuals and motivate them to conduct autonomous attacks against domestic targets. Data is presented to support the claim that domestic lone wolf terrorism is proliferating. Previous lone wolf attacks are analyzed, and a trend of increased frequency and mortality rates resulting from such attacks is established. This chapter then proposes that due to limited resources and expertise, critical infrastructure has become the preferred target selection for lone wolf terrorism.

Having established that domestic lone wolf terrorists are likely to perpetrate future attacks, developing a comprehensive understanding of their behavior becomes imperative. To address this need, a profile of lone wolf terrorists is presented, including demographic information such as age, gender, educational background, criminal history and mental illness rates. This information is later used to identify potential candidates for radicalization prevention or de-radicalization programs.

**Chapter II:**

Chapter two examines the prevalent schools of thought regarding the target selection process and seeks to establish if lone wolf terrorists display an identifiable behavioral pattern. The literature review seeks to identify commonalities in previous lone wolf attacks and uses that information to identify likely targets. This chapter then seeks to
determine if lone wolf attacks are random targets of opportunity or if a reasoned and rational target selection process is used.

The results and discussion portion introduces seven primary criteria used to determine the appeal of potential targets and how they correspond to the aviation sector. Finally, a comparison between the aviation sector and other critical infrastructure is conducted to establish the relative target value of each sector, concluding that the aviation sector most closely corresponds with the established target selection criteria.

**Chapter III:**

The last chapter analyzes various attack modalities and explores the tactical capabilities of lone wolf terrorists in an effort to determine what factors influence their decision to utilize specific weaponry. This portion includes variables such as a lack of expertise, training, technical equipment or access to information.

Having previously determined that airports are highly desirable and likely terrorist targets, this chapter explores various physical security measures that can be incorporated into airport designs to mitigate the effects of terrorist attacks. An examination of radicalization prevention and de-radicalization programs used in the United Kingdom, United States, and Saudi Arabia outlines the benefits and limitations of such programs. The chapter concludes with recommendations to prevent or mitigate future terrorist attacks in the aviation sector.

**Findings and Implications**

**Chapter I**

Chapter one first seeks to determine the severity of threat that overall terrorists pose to nation-states by examining the feasibility of using Weapons of Mass Destruction
(WMD) in attacks. The first challenge terrorist organizations face in developing WMD is the acquisition of precursory materials. Due to institutional regulations and monitoring by international bodies, respected scholars have determined acquiring sufficient amounts of weapons-grade nuclear or radiological material is difficult and improbable for terrorists.\(^2\) Further analysis reveals that even if the raw materials were to be acquired, considerable technical challenges may prevent the creation of such WMD as sophisticated machinery and technical expertise are required to construct a deployable weapon. The transport of WMD presents another security challenge as advanced detection devices and security screening locations make transporting weapons constructed overseas difficult to smuggle into Western nations. Finally, technical challenges make the dispersal of WMD unlikely.

Planning complex attacks requires ample resources and experienced leadership. However, years of military operations by the United States and allied nations have effectively degraded terrorist organizations’ planning capabilities. Al-Qaeda has suffered significant losses of top leadership who would be instrumental in planning large-scale attacks like they were in 9/11.\(^3\) A large portion of ISIS’s recruiting base and the corresponding revenues from oil, taxation, extortion, and kidnapping were contingent upon holding land, rendering this strategy no longer viable as ISIS has lost 100 percent of its land in Iraq and Syria.\(^4\)

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Because of operational and security challenges, terrorist organizations have modified their tactics by focusing more on their ideological message, which is delivered through various forms of propaganda and various conduits, including the use of social media (primarily Twitter), websites, and chatrooms. Organizational messaging has concentrated on recruiting and inspiring lone wolf terrorists, encouraging them to develop plots and self-mobilize. These propaganda efforts have corresponded with increases in both the frequency and lethality of lone wolf attacks since 9/11.

Establishing that lone wolf terrorism represents an emerging threat, it becomes imperative to analyze the capabilities and limitations of these terrorists. In many respects, lone wolf terrorists operate differently than organizational terrorists. Due to limited resources, training, and expertise, lone wolf terrorists tend to rely on easily acquired, easily operated weaponry and plan simple, executable attacks as opposed to the larger, more complex attacks that terrorist organizations often perpetrate. These limitations in attack modalities influence lone wolf terrorists’ target selection process, implying that they will likely attack soft targets, such as critical infrastructure, as it increases the probability of success. In order for security officials to effectively prepare for the emerging threat that lone wolf terrorists pose, a more comprehensive understanding of their offensive capabilities and their target selection process is required.

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Chapter II

Chapter one established that lone wolf terrorism is proliferating and that soft targets, such as critical infrastructure, are possible targets for lone wolf terrorists. However, minimal data is presented to support this claim; thus, chapter two seeks to determine the most likely targets of lone wolf terrorists by analyzing their behavioral tendencies and prior attack history. In order to predict likely targets, it must be determined if lone wolf terrorists act erratically or utilize a rational selection process. Despite data determining that 40 percent of lone wolf terrorists have experienced some form of mental illness, research indicates that in the majority of instances, a rational thought process was displayed when selecting targets. Other research indicates that attacks are generally not random. In many of the terrorist events studied, evidence of premeditation was present, including high degrees of in-person training, virtual training, and the physical possession of training materials. In addition, nearly one-third (29 percent) of lone wolf terrorists practiced dry runs before conducting the attack.

Having established that the majority of lone wolf attacks are premeditated and reasoned, it becomes necessary to determine the methodology that lone wolf terrorists use when selecting potential targets. Data indicates that lone wolf terrorists closely follow the attack profile of organizational terrorists. For example, 44 percent of group-based attacks

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in the United States took place within 30 miles of terrorists' residences.\textsuperscript{11} This is consistent with other data-driven analysis, which concludes that many solo terrorists do not leave their hometowns when attempting to carry out an attack. Statistics reveal that the majority of lone wolf attacks focus on civilian targets, while government targets were the second most common target.\textsuperscript{12} Understanding that lone wolf terrorists primarily target civilians and conduct missions within a close proximity to their residence, it becomes necessary to establish which civilian locations are the most likely to be targeted.

Professor Ackerman of New York State University, Albany, identifies primary motivating factors for the terrorist target identification and selection process. These criteria include: (1) casualties, (2) target value, (3) symbolic value, (4) economic impact, (5) psychological impact, (6) influence of similar attacks, and (7) interconnectedness. These criteria are then compared against various critical infrastructure, including the aviation sector, to determine the most appealing terrorist targets. While numerous critical infrastructure sectors meet several of the criteria, the aviation sector stands out for not only fulfilling all seven criteria, but also the magnitude for which they do so. For example, the March 22, 2016 ISIS attack on Brussels International Airport is estimated to have cost Belgium approximately $4.47 billion in lost revenue due to the closures of services such as transport, hospitality, and other businesses.\textsuperscript{13} An attack on a major U.S. airport projects to have even greater economic ramifications. Based upon a simulated

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terrorist attack on a U.S. airport and on a domestic airliner, the estimated impact on GDP exceeds $10 billion.\textsuperscript{14} In comparison, in 2008, India's GDP from tourism was slightly more than 10 billion dollars, yet just six percent of people planned to curtail travel to the region following the Mumbai attacks, resulting in relatively minor economic impact.\textsuperscript{15}

Because the aviation sector, specifically airports, represents a target that is susceptible to unsophisticated attacks, and is both a government facility that offers access to public targets and matches all established targeting criteria with a high magnitude, it is reasonable to conclude that airports represent a highly desirable and likely target for lone wolf terrorists. Understanding the desirability of airports as a target, the next chapter explores methods to protect these facilities and the people within them.

\textbf{Chapter III}

Having established that the aviation sector represents a highly desirable target based upon the target selection criteria established in the previous chapter, chapter three examines possible prevention and mitigation techniques and policies. In order to effectively mitigate attacks, the most likely attack modalities must first be determined. A study of numerous Western democratic nations found that lone wolf terrorists used firearms in 43 percent of attacks and explosives in 28 percent of attacks, armed hijackings accounted for 16 percent of all attacks, and six percent of attackers committed

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\textsuperscript{15} Ibid, 34-36.
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A separate study found that firearm attacks are increasing in frequency. While other attack modalities may be utilized, data indicates that firearms and bombings are the most prevalent threat.

Various security measures can be implemented to mitigate potential terrorist attacks. These mitigation techniques include the use of physical security measures, such as physical barriers, which have proven effective in mitigating numerous attack modalities. In the 2007 Glasgow Airport attack, concrete bollards located around the central terminal area stopped a vehicular ramming assault by terrorists. Physical security can also be incorporated into the design of airports. Modifications to the physical design of airport terminals and public areas, and the types of materials used to construct the structures, have the potential to deter or minimize the effects of detonations or shootings. Blast-proof materials reduce debris and minimize the potential for injury. Similarly, bullet-resistant windows and panels provide fixed location security for individuals located behind such barriers. While retrofitting airports with such materials entails additional costs, the cost of human life and a non-operational terminal, resulting from terrorist attacks, generally exceeds the initial investment, justifying the expenditure.

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Visual deterrents, such as having a strong police presence, have proven effective in preventing various forms of criminal activity. For example, a control group found that police protection induces a decline in auto theft of approximately 75 percent when concentrated in specific high occurrence areas.\footnote{R. D Tella and E. Schargrodsky, “Do police reduce crime? estimates using the allocation of police forces after a terrorist attack,” \textit{The American Economic Review}, 94 no. 1 (2004): 115-133.} However, such studies indicate that in order for high visibility deterrents to be effective, a visible police presence is required at numerous locations continuously.\footnote{Ibid.} While it is unlikely that terrorists would be deterred as easily as thieves, terrorists are more inclined to conduct attacks on targets they perceive as vulnerable; the presence of armed police officers is likely to cause some terrorists to identify alternate targets. The indefinite use of this tactic can place significant stress on resources and inflict physical strain on police personnel, drawing into question the long-term viability of such a strategy.

Having established that explosives are the second most common attack modality, early detection of explosive devices may potentially prevent detonation by allowing police bomb units to neutralize the devices. Explosive detection is accomplished by using a combination of machine detection devices and animal detection. K-9s have the advantage of being highly mobile and have proven to be very effective at identifying explosive materials. During testing, K-9s have displayed a detection rate of 91.46 percent\footnote{Irit Gazit, \textit{Explosive detection by sniffer dogs following strenous physical activity}, (Tel Aviv: Elservier, 2001), 154.} identifying various chemicals commonly used in explosives such as TNT, C4,
commercial dynamite, and Semtex. Fixed detection devices at security screening locations represent another investigation option. Devices such as ion mobility spectroscopy collect vapor samples and detect common explosive chemicals such as RDX (used in C-4) and PETN (used in Pentolite). However, such devices have limitations. For example, environmental conditions and the small vapor pressures of explosives often make detection of many samples difficult or inconclusive.

Early detection of weapons or potential terrorists provides an opportunity for law enforcement officers to intercede prior to an attack. Enhancing early detection capabilities improves the likelihood of a successful intervention. CCTV systems integrated with artificial intelligence programs, such as facial recognition technology, can be installed in public and sterile areas of airports and related infrastructure and can allow law enforcement officials to crosscheck suspects against existing terrorist watch lists. While technology provides a supplemental resource, law enforcement and security personnel who receive comprehensive training to detect suspicious behavior through behavioral detection programs improve the likelihood of identifying terrorist suspects prior to an attack.

While the above-mentioned mitigation technologies and techniques have proven effective in limited capacities, perhaps the most effective way to mitigate terrorism is to

prevent the radicalization of terrorists. Both the U.S. and U.K. have instituted counter-radicalization programs that are designed to proactively mitigate root causes, frames, the proliferation of radical ideology, and social networks that lead to violent radicalization.

Countering violent extremism (CVE) programs are far from universal successes. CVE programs in both the U.K. and U.S. lack cohesive strategies, which has impeded counter-radicalization efforts. Although CVE programs in the U.S. and U.K have adequate funding, wasteful spending and distributions to controversial institutions have caused watchdog organizations to question the administration of funds. CVE programs have disproportionally concentrated on members of the Muslim community, creating allegations of racial profiling and having the inadvertent effect of alienating portions of the population that they are attempting to engage. While constitutional limitations serve to protect individual liberties, they also effectively restrict the scope of authority of certain CVE programs operating in democratic nations.

Recognizing that lone wolf terrorism is increasing, and that inherent operational limitations influence their target selection process, critical infrastructure, specifically the aviation sector, has been identified as a likely target. Various technologies, counter-radicalization programs, and law enforcement deployment strategies can be utilized to mitigate or potentially prevent lone wolf attacks against the aviation sector. Given the seriousness of the threat and the potential ramifications of a successful lone wolf terrorist attack against airports and related infrastructure, additional research must be conducted to enhance security officials’ defensive capabilities.
I. THE PROLIFERATION OF LONE WOLF TERRORISM AND THE CORRESPONDING THREAT TO CRITICAL INFRASTRUCTURE

Introduction

The U.S. and its allies have systematically targeted the two most prominent terrorist organizations in the world through a combination of military actions, intelligence operations, and various financial instruments. As a result, Al-Qaeda and ISIS have both experienced significant losses in terms of manpower, financial resources, and the amount of physical territory held under their control. Consequently, their ability to plan and execute major terrorist operations has been diminished. Cognizant of their circumstances, terrorist organizations have shifted their focus from planning and executing major offensive operations to actively encouraging potential sympathizers worldwide to join the jihad and launch low-tech attacks in areas not encompassed within the caliphate. The proliferation of terrorist attacks is not restricted to radical Islamic terrorism. Events such as the Oklahoma City bombing show that domestic terrorists and lone wolf actors pose a substantial risk to the safety and security of nation-states and their citizenry.

Proactive security measures must be taken to detect, deter, mitigate, and potentially prevent attacks resulting from the constantly evolving terrorist threat. In order to successfully accomplish these objectives, a thorough risk assessment needs to be conducted to determine both the nature of the threat and the likely targets. This chapter proposes two primary concepts: (1) that the effective degradation of terrorist organizations by the U.S. and allied nations has contributed to the proliferation of lone wolf terrorism, and (2) that the greatest vulnerability to lone wolf terrorism is critical infrastructure.
**Literature Review**

**The Threat of Lone Wolf Terrorism to Critical Infrastructure**

Many consider the greatest threat that terrorist organizations pose is a well-coordinated attack using WMD on high-profile Western targets resulting in mass casualties. This literature review challenges this widely-held belief by proposing that the degradation of prominent terrorist organizations’ offensive capabilities has led to the proliferation of smaller scale lone wolf attacks. Consequently, this review proposes that due to limited resources and expertise, critical infrastructure has become the preferred target for lone wolf terrorists.

The attacks of 9/11 have fundamentally influenced politicians, military leadership, and the intelligence community so profoundly that much of the current counter-terrorism policy is still predicated around preventing a comparable WMD event from occurring. Although WMD terrorism remains rare, the Central Intelligence Agency has reported for the last several years that terrorist interest in WMD is growing, as is the number of potential perpetrators.27 James Forest, an associate professor and director of the Center for Security Research and Technologies at the University of Massachusetts Lowell, makes a clear delineation between “amateur” terrorists and sophisticated multinational organizations that are capable of planning and conducting complex, high profile attacks.28 Brian Michael Jenkins, a senior advisor to the president of the RAND Corporation and director of the Mineta Transportation Institute's Transportation Security Center, states the objective of terrorism is to further their ideological

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goals by inflicting the greatest amount of psychological fear upon their victims.29 According to Professor Mustafa Kibaroglu of the Department of International Relations at Bilkent University, WMD attacks have been identified as the most destructive and high profile attacks a terrorist organization can aspire towards.30

While groups such as Al-Qaeda and ISIS remain prominent and continue to maintain a functional ability to plan and execute offensive terrorist operations against ideological enemies, a combination of military actions, intelligence operations, and various financial instruments, including seizures of funds and sanctions against nations believed to be harboring terrorists, have weakened these organizations. As a result, Al-Qaeda and ISIS have both experienced significant losses in terms of manpower,31 financial resources, and the amount of physical territory held under their control.32 Consequently, their ability to plan and execute major terrorist operations has been diminished. Cognizant of their circumstances, terrorist organizations have shifted their focus from planning and executing major offensive operations to actively encouraging potential sympathizers worldwide to join the jihad and launch low-tech attacks in areas not encompassed within the caliphate.33

Ramón Spaaij, a research fellow at the Amsterdam School for Social Science research at the University of Amsterdam, states that lone wolf terrorists operate mostly autonomously, with

29 Brian Jenkins, Understanding the Link Between Motives and Methods Terrorism, with Chemical and Biological Weapons: Calibrating Risks and Responses, by Brad Roberts, (Alexandria, VA: Chemical and Biological Arms Control Institute, 1997), 121-140.
minimal resources and training.\textsuperscript{34} Due to minimal resources, lone wolf terrorists have favored soft targets, which are susceptible to low-tech, non-resource intensive attacks.\textsuperscript{35} However, similar to more formal terrorist organizations, the primary objective for lone wolf terrorists remains the maximization of fear and intimidation to further their ideological and political goals. Logical targeting selection processes have increased the likelihood that critical infrastructure will be targeted.

According to Professor Bruce Hoffman, the director of the Security Studies Program at Georgetown University, the practicality of terrorist organizations acquiring the precursory materials to develop WMD, generally classified as one of chemical, biological, radiological, nuclear, or explosive, has been presented as difficult and even unlikely.\textsuperscript{36} Further analysis reveals that even if the raw materials were to be acquired, considerable technical challenges may prevent the creation of such WMD. Additionally, the transport, deployment, and dispersal of WMD presents another daunting technical and security challenge.\textsuperscript{37} While many agree that terrorist organizations would carry out a WMD attack if possible, others contend that the possibility of retaliation from nation-states affected by the attacks serves as deterrents for rational actors. Thus, only irrational actors, ideologically driven organizational leadership or lone wolf terrorists with nothing to lose beyond their own lives are the most likely candidates to execute such high-profile attacks.

\textsuperscript{35} Ibid.
In later works, Professor Hoffman expands upon the inherent difficulties that terrorist organizations face in recruiting, planning, training, and executing WMD attacks. Hoffman concludes that because of these challenges, terrorist organizations have modified their tactics by focusing more on their ideological message. This messaging often occurs through various forms of propaganda, with the intention of recruiting and inspiring lone wolf terrorists to develop and deploy WMD. This complicates the investigative process for law enforcement officials. Lone wolf terrorists are typically more difficult to detect and track due to limited communication and a lack of organizational constraints. Due to inherent resource restrictions, lone wolf attacks are often simplistic in nature, making locations with minimal security, high population densities, cultural or symbolic significance, and economic importance ideal targets.

This review will serve to bridge prior contributions by establishing two correlations vital to the protection of national economic and societal functions: (1) that the degradation of terrorist organizations has spawned an even greater threat in lone wolf terrorism, and (2) that the logical target for lone wolf terrorists is critical infrastructure.

The Practicality of Terrorists using WMD

Richard Falkenrath, a senior fellow for national security at the Council on Foreign Relations, articulates the belief that terrorist organizations desire to develop and deploy WMD as a means of obtaining their ideological or political goals. Yet very few WMD attacks have been

successfully conducted by terrorist organizations throughout the world. Perhaps this is due to the sheer amount of resources required to execute such an attack, which are currently possessed by a very small number of terrorist organizations. The most infamous WMD attack, 9/11, caused many to question what qualifies as a WMD. The FBI definition, which proposes with specific detail, any of chemical, biological, radiation, nuclear, or explosive attacks, is generally encompassing but does not account for unconventional WMD, such as the use of aircraft during 9/11.

In his congressional research report, Steve Bowman, a specialist in the National Defense Foreign Affairs, Defense, and Trade Division, argues that the ability of terrorist organizations to acquire the necessary materials, construct, transport, and deploy WMD is limited by technical and political factors. For example, chemical agents require complex delivery mechanisms, expensive machinery that requires specific knowledge to operate, and technical expertise to develop. The idea that terrorist organizations can acquire fully developed nuclear weapons from nation-states appears improbable as the supplier nation will almost certainly face such severe reprisal from the international community that it simply does not make sense from a cost-benefit perspective. The same can be said for terrorist organizations themselves, as such an attack would almost certainly elicit a response that jeopardizes the very survival of said organization.

43 Title 18 U.S.C. §2332a
The question of rational vs irrational actors then needs to be proposed. Would a rational actor launch a WMD attack against a militarily superior nation? If so, does the likely retaliation act as a viable deterrent? The answer to these questions depends on the ideological commitment of the terrorist organization or the nation providing WMD to terrorist organizations. Hoffman concludes that religiously motivated terrorists are more likely to conduct such attacks as their fundamental belief in their cause and the promise of rewards in the afterlife outweigh the negative repercussions such as imprisonment, death, or even the complete destruction of their terrorist organization. This contrasts with politically motivated terrorists, who may be less inclined to conduct such attacks due to the possibility of alienating potential sympathizers. Brian Michael Jenkins, a senior adviser at the Rand Corporation, proposes that WMD attacks are antithetical to the primary objectives of terrorism, as terrorists want a large audience to be fearful, and that WMD attacks simply kill too many of the desired target audience.\(^{47}\)

The dynamic that has not been addressed is the actual offensive capability of modern terrorist organizations given years of military, financial, and recruitment infrastructure bombardment by the U.S. and allied nations. ISIS, for example, has lost 100 percent of its land in Iraq.\(^{48}\) A large portion of ISIS’s recruiting base and the corresponding oil revenues were derived from holding land.\(^{49}\) Al-Qaeda has suffered significant losses of top leadership, who would be instrumental in planning WMD attacks like they were in 9/11.\(^{50}\) A combination of all of the


factors discussed above have limited terrorist organizations and their ability to conduct WMD attacks. This does not mean that they are idle in their efforts to spread their ideology and inflict as much economic, psychological, and physical trauma upon their enemies as possible. Rather, they simply have been pragmatic in their analysis and consciously evolved their strategies to incorporate an underutilized resource in their battle with the enemy.

The Emergence of Lone Wolf Terrorism

To determine if lone wolf terrorist attacks are increasing, a comprehensive analysis needs to be conducted as locations, lone wolf terrorism definitions, and year selection samples are all contributing variables that have produced conflicting data. In 2003, FBI director Robert Mueller stated “the threat from single individuals sympathetic or affiliated with al-Qaeda, acting without external support or surrounding conspiracies, is increasing.” This assessment appears to be consistent with the data collected from Indiana State University Professors Mark S. Hamm and Ramon Spaaij, which concludes that of 98 cases of lone wolf terrorism studied, 38 cases occurred before the terrorist attacks of 9/11 and 60 took place after. The study then addresses another variable that may result in inconsistencies by stating that 15 of the cases involved a confidential informant or a law enforcement member in a sting operation, thus implying that they may not be authentic lone wolf cases as more than one member is involved. Hamm and Spaaij then elect to measure the lethality of lone wolf attacks as opposed to the total number of attacks. They conclude that lone wolf terrorism in America is not on the rise.

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Dr. Jasparro, an associate professor in the National Security Affairs Department at the Naval War College, provides a more vigorous repudiation to the notion that lone wolf terrorism constitutes a threat significant enough to rival that presented by terrorist organizations. Jasparro states “…it seems that independent terrorists have a poor record of success and that the most serious threats are still posed by established jihadist groups or cells that are closely connected to such groups or wider jihadist networks.”\(^53\) He does acknowledge, “This does not mean the threat should be taken lightly. Past experience has shown that weakly connected and even fairly unskilled groups can carry out deadly attacks if they make the right connections.”\(^54\) These sentiments are prevalent despite inconsistencies within the methodology defining and accounting for lone wolf terrorist attacks.

Hamm and Spaaij support their conclusion by referencing the higher casualty rates of the 1990s, when lone wolf terrorists in America accounted for 212 victims, killing 30 and wounding 182 others. However, even when considering lethality as a variable, it must be noted that the data used in this study only runs through 2013. According to Simon, current trends indicate that even by measuring lethality, lone wolf attacks are on the rise.\(^55\) This is consistent with the recent lone wolf attacks, such as the Pulse night club shooting in Orlando, Fl., in which 49 people were killed and 53 were injured,\(^56\) or the Nice truck attack in which 86 people were killed and over

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54 Ibid.
200 were injured by a single perpetrator. Those two attacks alone account for 135 fatalities and at least 253 injuries, surpassing the totals for all of 1990-2000. This data indicates that even if Jasparro’s assertion that lone wolf attacks have a poor track record of success, due to the lethality of their attacks, only a small number of lone wolf attacks need to be successfully executed to have a deleterious effect on society. Furthermore, a 2003 study by Professor Christopher Hewitt of the University of Maryland, revealed that between 1955 and 1999 lone wolf terrorists accounted for just two percent of all terrorist arrests, but resulted in 15 percent of terrorist fatalities. According to Spaaij “Overall, the total number of lone wolf attacks has grown from 30 in the 1970s to 73 in the 2000s, an increase of 143 percent.” If scholars can conclude that lone wolf terrorism is on the rise and constitutes a significant threat, then the next logical question becomes why?

Mark Juergensmeyer, a professor of sociology and global studies at the University of California Santa Barbara, believes the psychological and emotional reasons why individuals radicalize and aspire toward terrorism is a complex study. Isolation and exclusion from society may prompt some to feel disconnected from the common social milieu. Other experts present psychological illness as an alternative hypothesis for why individuals radicalize, but a recent trend of religiously inspired radicalization has emerged as a major contributing factor. Prominent

58 Christopher Hewitt, Understanding Terrorism in America: From the Klan to Al-Qaeda (New York: Routledge, 2003).
terrorist organizations such as ISIS, who once controlled 34,000 sq. miles of land stretching across Syria and Iraq has lost all of its territory\(^\text{62}\) and Al-Qaeda, who has lost a significant amount of its leadership in military strikes by the U.S. and allied nations.\(^\text{63}\) Al-Qaeda and ISIS have placed an emphasis on propaganda efforts to disseminate radical ideology with the intent of inspiring sympathetic individuals. Hoffman elaborates by stating, “this new strategy of al-Qaeda is to empower and motivate individuals to commit acts of violence completely outside any terrorist chain of command.”\(^\text{64}\) To help facilitate this process, bombmaking and tactical videos have been produced and distributed online in the hopes that potential lone wolf terrorists will acquire the skill set necessary to mobilize.

The proliferation of terrorist-inspired religious propaganda helps to account for the motivations of lone wolf terrorists and helps to make sense of the supporting data. In his 2009 study, Spaaij found that between 1968 and 2007 lone wolf terrorism only accounted for 1.28 percent of all terrorist incidents worldwide, but in the U.S., it accounted for 42 percent of all cases, with white supremacist, Islamist and nationalist/separatist motivations topping the ideological sources for lone wolf attacks.\(^\text{65}\)

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\(^{64}\) Bruce Hoffman, Inside Terrorism (New York: Columbia University Press, 2006).

Targeting Critical Infrastructure

Historian Walter Laqueur has proposed that lone wolf terrorists are amongst the likeliest to conduct a WMD attack, as they are not restricted by the same limitations as organizational terrorists. 66 Lone wolf terrorists do not need to concern themselves with retaliation from nation-states, reactions from the public that may alienate them from political sympathies, nor do they need to concern themselves with unwanted attention from law-enforcement or possible reprisal from other terrorist organizations who may interpret the attack as counterproductive. 67 Despite the prior assertions, only one instance of a lone wolf terrorist threatening to use a WMD in an attack has been recorded. In 1974, the Alphabet Bomber, Muharem Kurbegovic, threatened to use a chemical agent, sarin. Contrary to Laqueur’s claim, Spaaij suggests that no empirical evidence exists to suggest that lone wolf terrorists are likely candidates to use WMD. 68

Due to limited resources, training, and expertise, lone wolf terrorists tend to rely on easily acquired, easily operated weaponry. The weaponry of choice for lone wolf terrorists is predominantly firearms followed by explosives and armed hijacking. 69 Thus, their target selection must be vulnerable to such weaponry. The franchise hypothesis, proposed by Martin C. Libicki of the Rand Corporation, posits that terrorist organizations such as Al-Qaeda lack the resources to conduct certain operations abroad thus encouraging such organizations to focus on inspiring others to conduct offensives attacks. 70 By studying the target pattern of Al-Qaeda, one

69 Ibid.
can determine that ideal targets will provide high media visibility, serve a vital economic
function, cause maximum disruption to societal functions, provide the potential for mass
casualties, and inflict the greatest psychological fear possible.\textsuperscript{71}

Critical infrastructure has been defined as “systems and assets, the destruction or
incapacity of which would cause catastrophic health effects or mass casualties comparable to
those from the use of weapons of mass destruction, impair Federal departments and agencies’
abilities to perform essential missions or ensure the public’s health and safety, undermine State
and local government capacities to maintain order and deliver minimum essential public
services…, have a negative effect on the economy through the cascading disruption of other
critical infrastructure, or undermine the public’s morale and confidence in our national
economic and political institutions.”\textsuperscript{72} Specific examples of critical infrastructures included:
telecommunications, electrical power systems, gas and oil storage and transportation, banking
and finance, transportation, water supply systems, emergency services (including medical,
police, fire, and rescue), and continuity of government.\textsuperscript{73}

Recent notable terrorist attacks that coincide with critical infrastructure targeting includes
the Brussels Airport 2016,\textsuperscript{74} a natural gas field and processing plant in Krechba, Algeria, which

\textsuperscript{71} Audrey Kurth Cronin and James M. Ludes, \textit{Attacking Terrorism Elements of a Grand Strategy}
\textsuperscript{72} John Moteff, \textit{Critical Infrastructure: Background, Policy and Implementation} (Washington DC:
\textsuperscript{73} John Moteff, Claudia Copeland and John Fischer, \textit{Critical Infrastructures: What Makes an Infrastructure
\textsuperscript{74} Tim Hume, Tiffany Ap and Ray Sanchez, “Here’s what we know about the Brussels terror attacks,”
belgium-attacks-what-we-know/.
suffered a rocket attack by an Al-Qaeda affiliate, and numerous attacks on police officers, making 2016 the deadliest year for terrorist-initiated attacks on law enforcement since the 1970s.

Inspired by weakening terrorist organizations, lone wolf terrorists seek to create the greatest amount of psychological fear, economic disruption, and physical destruction while simultaneously obtaining the greatest media exposure possible. The logical progression in future lone wolf attacks will likely target critical infrastructure as these specific locations tend to meet all of the criteria stated above and generally can be classified as soft targets, which are susceptible to the weaponry most commonly available to lone wolf terrorists and require prolonged periods of repair, thus giving lone wolf terrorists optimal and executable missions.

Who are Lone Wolf Terrorists?

A long-desired goal of counter-terrorism experts is the creation of a standard profile to identify terrorist suspects. Theoretically, such a profile would significantly increase the efficiency in which suspects are identified and monitored, which would in turn lead to a reduction in terrorist attacks through preemptive interventions or arrests. However, the challenge of creating such a profile has proven elusive, as terror suspects cover a wide spectrum of ideology, age, gender, employment status, marital status, etc. This does not mean that there is a dearth of data points to use for generalized inferences. While the following information does not constitute and is not intended to formulate a standard profile, it does represent statistical averages.


and general characteristics of lone wolf terrorist suspects in comparison to terrorist suspects who elect to join terrorist organizations. These characteristics are of particular importance as terrorist organizations attempt to craft a compelling message to inspire the mobilization of potential lone wolf terrorists. Similar to a commercial marketing campaign, these organizations must understand the parameters of the group to which they must appeal, and the best platforms in which to do so. Conversely, governments seeking to prevent such radicalization must be cognizant of those members of society who are the most vulnerable to radical propaganda and their delivery methods.

Age

A stark contrast exists between the average age of lone wolf terrorists and those who elect to join terrorist organizations. An empirical study by Gill, Horgan and Deckert concluded that the range of lone wolf terrorists committing their first terrorist offense in the U.S. and Europe was 15-69 years old with an average age of 33 years old,77 while, according to Sageman, the average age of Al-Qaida-related terrorists was 26 years old.78 In respect to ISIS, the youngest suspect arrested in the U.S. was a 15-year-old boy, the oldest was Tairod Pugh, a former Air Force officer who was 47 at the time of his arrest. The average age of the American ISIS supporter at the time charges were filed was 26 years old.79 Age plays a particularly important role in recruitment and radicalization methodology as the platforms used to reach a 33-year-old

may differ greatly from those used to communicate with a 26-year-old. While both would likely be accessible via the internet, websites and chatrooms, newer social media outlets such as twitter and snapchat tend to attract a younger user base, while in-person radicalization may prove more appealing to older recruits. Technological influences may skew the average age of lone wolf terrorist downward in the coming years.

**Gender**

One characteristic that is easily discerned within lone wolf terrorism is the gender divide. Across the U.S. and Europe, 96.6 percent of lone wolf terrorists are male, with females accounting for just 3.4 percent of the lone wolf terrorist population. Only four cases of females behaving in this capacity have been documented.\(^80\) While the participation rates of females within terrorist organizations remains proportionately low, an obvious dichotomy exists. A study of ISIS supporters in the U.S. revealed that 86 percent are male and 14 percent are female. This represents a participation rate over four times greater amongst female ISIS supporters than lone wolf terrorists.\(^81\) It is important to note that the roles of women within terrorist organizations often differ greatly from those of men. Women often function in a supportive capacity and serve as wives to male combatants while men do the vast majority of the fighting.\(^82\)

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Criminal History

The incarceration rate for lone wolf terrorists is high compared to incarceration rates of the general population and members of terrorist organizations. Data reveals that across the U.S. and Europe, 41.2 percent of lone-actor cases had previous criminal convictions prior to committing acts of lone wolf terrorism. Amongst those with previous criminal convictions, 63.3 percent served time in prison, and while serving their sentence, 32.3 percent experienced events or were influenced by individuals that contributed to their radicalization.\(^\text{83}\) While a high percentage of lone wolf terrorists have previous criminal histories, terrorist organizations favor individuals with a relatively clean past. Of ISIS members arrested for plotting attacks against Western targets, 22 percent were known to have past criminal records or were in contact with law enforcement.\(^\text{84}\) The most common felonies were drug related. Among ISIS inductees, only 13 percent had been convicted of a violent crime.\(^\text{85}\) The logical explanation for this significant variance is the necessity for members of terrorist organizations to be able to move and operate freely without the restrictions and law-enforcement attention that is associated with prior criminal convictions.

Economic Standing

Poverty has long been considered to be a major impetus for individuals to radicalize. The unemployment rate amongst terrorists is highly variable depending on their geographic location.


The evidence indicates that lone wolf terrorists in the U.S. typically have higher unemployment rates than their organizational counterparts. In the U.S., 40.2 percent of lone wolf terrorists were unemployed and 9.8 percent were students. The other half of the sample were employed but at lower quality jobs, for example, 23.2 percent were employed in the service industry and just 10.7 percent were employed in professional occupations.\(^6\) Of the lone wolf terrorists sampled, “many were chronically unemployed and consistently struggled to hold any form of employment for a significant amount of time.”\(^7\) Of those lone wolf terrorists who were unemployed at the time of attack or arrest, 26.6 percent had lost their jobs within six months and a further 15.5 percent between seven and twelve months before the event.\(^8\) Approximately 52.2 percent experienced financial problems. Of this subsample (30 individuals), 56.6 percent experienced financial problems within a year of their terrorist attack or plot.\(^9\) Meanwhile, the unemployment rate for individuals in the U.S. charged with ISIS-related offences was just 23 percent, 31 percent were students and 46 percent were employed.\(^10\) This is a potential indicator that financial deprivation does not strongly correspond with organizational terrorism, but may be a contributing factor in the mobilization of lone wolf terrorism.

**Education**

The level of education obtained by lone wolf terrorists varies greatly. Some, like Ted Kaczynski, aka the “Unabomber”, were highly educated. In Kaczynski’s case, he obtained a

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\(^7\) Ibid.

\(^8\) Ibid.

\(^9\) Ibid.

degree from Harvard and taught mathematics at the University of California at Berkley, while other lone wolf terrorists were high school dropouts. In total, 24.7 percent of lone wolf terrorists either attended or completed high school or secondary education, 32.5 percent either attended a community college, trade school, or university undergraduate education without graduating, 22.1 percent completed some form of community college, trade school, or university education and graduated, of the 20.8 percent that participated in graduate school, 6.5 percent graduated with a master’s degree, 7.8 percent graduated with a doctoral degree and the remaining percentage failed to graduate. In contrast, terrorist organizations tend to have a more highly educated membership base at the college level, with approximately 33 percent receiving a college degree. However, only five percent had a master’s degree and four percent had the equivalent to a doctoral degree, both less than lone wolf terrorists but not statistically significant. This preference for a highly educated membership may be attributable to terrorist organizations operational and planning needs. Possessing a formal education may assist organizational terrorists with the research, planning, financing, and logistical expertise required for large scale attacks while lone wolf terrorist attacks tend to be more simplistic and often do not require extensive planning and logistical support.

Refugees

The majority of terrorist attacks emanate from individuals who were born in the same nation that the terrorist attacks were conducted. Of the lone wolf terrorists radicalized to Jihadist

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terrorism, 73 percent were born in the United States.93 These figures coincide with the 27 percent of Mujahedin who grew up in a Western country as refugees.94 Of the ISIS inductees arrested in the U.S., 83 percent were U.S. citizens, and 65 percent were born in the U.S., only three percent were refugees and none were a refugee from Syria.95 Terrorist attacks by refugees are extremely rare, the annual chance of being killed in a terrorist attack committed by refugees is one in 3.6 billion.96

Marital Status

Another striking juxtaposition is the relationship status between lone wolf terrorists and organizational terrorists. Fifty percent of lone wolf terrorist were single and had never married, 24.4 percent were married, and 18.9 percent were divorced or separated.97 In contrast, 73 percent of Al-Qaida-related terrorists were married.98 However that figure dramatically shifts when analyzing ISIS members in the U.S., of which 50 percent were single and 42 percent were involved in some form of a relationship, with 32 percent married, five percent having a partner and four percent were engaged.99 It is uncertain what accounts for the large variances in marital status between organizational members. It is possibly attributable to ideological differences that

93 Brian Michael Jenkins, Stray Dogs and Virtual Armies Radicalization and Recruitment to Jihadist Terrorism in the United States Since 9/11 (Santa Monica: Rand Coporation, 2011).
motivate some members to pursue a more traditional family structure while others may become more detached from the traditional societal paradigm.

Mental Illness

Slightly less than a third, 31.9 percent, of lone wolf terrorists from the U.S. and Europe had a history of mental illness or personality disorder.\textsuperscript{100} The mental illness rate for far-right lone wolf terrorists is moderately higher than terrorists motivated by other ideologies, as 40 percent of far-right lone wolf terrorists experienced some form of mental illness. Both of these data sets support the notion that the rate of occurrence for lone wolf terrorists is significantly higher than the 7.6 percent mental illness rate documented amongst organizational terrorists.\textsuperscript{101} Using the data sets available, a lone wolf terrorist is 13.49 times more likely to have a mental illness than an organizational terrorist.\textsuperscript{102} This data is consistent with Pape’s findings, in which only 14 percent of ISIS inductees in the U.S. had confirmed mental illness.\textsuperscript{103} The relatively low rate of mental illness among organizational terrorists may be attributable to the notion that mentally unstable individuals simply do not fit into organizational structures, create discontent, are unpredictable and cannot be relied upon to follow orders as decreed by organizational leadership.


While lone wolf terrorists may desire to be accepted by a group, those with mental illness may end being rejected and ultimately feeling even more isolated.

**Religious Converts**

Of the Al-Qaeda inspired lone wolf terrorists, 37.3 percent were religious converts.\(^{104}\) This signifies a higher conversion rate than is typically experienced amongst organizational terrorists. Approximately 29 percent of those individuals involved in ISIS-related terrorist plots were religious converts.\(^{105}\) However, the conversion rate amongst individuals indicted for ISIS-related charges in the U.S. is significantly higher than both lone wolf and organizational terrorists across Western nations, with a 51 percent conversion rate.\(^{106}\) Regardless of the metrics, religious conversions represent a significant threat in both lone wolf and organizational terrorists, but constitutes a greater contributing factor in the U.S. than in other nations.

**Radicalization of Lone Wolf Terrorists**

Now that a set of proclivities has been established, these behavioral indicators will be applied in a conceptual framework that analyzes the radicalization of lone wolf terrorists. The process of radicalization will later be applied to a case study with the intent of modeling and testing commonly accepted theories of causation and the extent to which they are directly applicable to the radicalization of lone wolf terrorists.


Root Causes

In his article “Exploring the ‘Root Causes’ of Terrorism,” Newman states “The basic concept of the root causes of terrorism is that certain conditions provide a social environment and widespread grievances that, when combined with certain precipitant factors, result in the emergence of terrorist organizations and terrorist acts. These conditions — such as poverty, demographic factors, social inequality, exclusion, dispossession, and political grievance.”107 Analyzing these root causes reveals a series of potential indicators. While some of these conditions, such as poverty, have already been addressed, the remaining relevant conditions will be examined below.

Demographic Factors

While the motivations for lone wolf terrorists vary greatly, the most common societal perception is that violent radical Islam is the predominate motivating factor. Consequently, Muslims are often perceived as the members of society with the greatest likelihood of conducting a terrorist related attack. This sentiment is not unique to a particular Western country, in America, Anti-Muslim hate crimes are still five times more common today than before 9/11.108 In Europe a significant percentage of people believe that immigration is a bad thing, with the number in Spain standing at 33 percent, in France at 41 percent, in Great Britain at 32 percent, and in Germany at 59 percent.109 This sentiment continues to be prevalent despite the fact that

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the majority of lone wolf terrorism is perpetrated by native born individuals. Pape’s findings, indicate that of the individuals indicted on ISIS related offenses in the U.S. most are “born and raised in America, 83 percent are US citizens, and 65 percent were born in the US.”

Exclusion and Isolation

Vulnerable individuals who feel disconnected from society are more inclined to explore alternate ideologies to rationalize their state of exclusion. Lone wolf terrorists tend to be highly susceptible to feelings of isolation. Jasparro’s 2010 study supports this conclusion by finding that, of the 14 American lone wolf terrorists studied, nine were described as ‘loners’ by friends and family. Gill found that more than a quarter (26.9 percent) of lone wolf terrorists adopted their radical ideology when living away from home in another town, city, or country. At least 37 percent lived alone at the time of their event planning and/or execution, a further 26.1 percent lived with others, and no data were available for the remaining cases more than half (52.9 percent) were characterized as socially isolated by sources within the coded open-source accounts. According to Hamm and Ramon Spaaij’s study “The findings imply that lone wolf terrorism is caused by relative deprivation. In their social exclusion, lone individuals feel deprived of what they perceive as values to which they are entitled, and form grievances against

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the government responsible for their unemployment, discrimination, and injustices. Their violence is a deviant adaptation to this gap between means and goals.”

*Political Grievances*

Often feeling isolated and excluded from society, lone wolf terrorists frequently meld their personal grievances with overarching political grievances. Spaaj supports the correlation between personal and political grievances and applies it to lone wolf terrorists. For cases of lone wolf terrorists prior to 9/11, evidence of combining personal and political grievances was found in 30 of the 38 cases studied, approximately 80 percent of the cases. For lone wolf terrorists post-9/11, evidence of combining personal and political grievances was found in 36 of the 45 cases, also representing 80 percent of the cases. This data is significant in delineating lone wolf terrorists from their organizational counterparts, as organizational terrorists tend to share collective grievances.

*Frames and Ideology*

As defined by Dalgaard-Nielsen “A frame is an individual’s worldview, consisting of values (notions about right and wrong) and beliefs (assumptions about the world, attributes of things, and mechanisms of causation.)” Frames are often influenced by radical ideology. Baker’s study supports the notion that individual frames are influenced by ideology at the time of radicalization, stating “With regard to the faith of persons at the time of joining the jihad, it is not surprising to see that in many cases (58 of the 61 in which we found reliable information) faith

114 Ibid.
increased in the months before recruitment. Fifty-five of the would-be jihadi terrorists participated in courses on the Koran (at home or abroad) or were vigorously debating Islam on the internet. Others tried to convert acquaintances or colleagues or changed liberal mosques for more orthodox or extremist ones. “116

Religiously inspired lone wolf terrorists constitute the largest sect of actors at 43 percent.117 With regards to ideology, 43 percent were motivated by al-Qaeda, 34 percent by right-wing ideology and 18 percent by a single issue. The remaining five percent was classified as other.118 This data is consistent with Teich’s summary of trends and developments in lone wolf terrorism in the Western world, in which nine lone wolf perpetrators were specifically motivated by the radical teachings of Al-Awlaki, two were specifically motivated by the teachings of Abu Hamza, one specifically supported Hezbollah, and the remaining 61 were generally motivated by the Al-Qaeda ideology, radical Islam or Jihad, or the Palestinian or Islamic cause.119

Propaganda and Internet Radicalization

According to Anja Dalgaard-Nielsen, the director of the Institute for Strategy at the Royal Danish Defence College, “radicalization occurs as individuals seek to reconstruct a lost identity

118 Ibid.
119 Sarah Teich, "Trends and Developments in Lone Wolf Terrorism in the Western World An Analysis of Terrorist Attacks and Attempted Attacks by Islamic Extremists." *International Institute for Counter-Terrorism* (2013)
in a perceived hostile and confusing world.”

While the traditional methods of social networks and in-person recruitment still represent significant contributing factors, the internet has emerged as the preeminent mechanism of radicalization by providing a cathartic escape and instilling a sense of community and identity for individuals who are frequently isolated and deprived. This phenomenon is described by Musa and Bendett, “During the indoctrination phase, those undergoing self-administered brainwashing devote their time in the cyber world to extremist sites and chat rooms—tapping into virtual networks of like-minded individuals around the world who reinforce the individual’s beliefs and commitment and further legitimize them.” Once active, vulnerable individuals may seek additional inputs that reinforce their perspective.

Online propaganda materializes in different forms, all of which have varying degrees of effectiveness, but according to Professor Robert Pape of the University of Chicago, 83 percent of inductees reported watching ISIS videos, including videos of executions, which ISIS distributes on the internet. This directly corresponds with the proliferation of terrorist websites that promote propaganda and other radical material. In 1998, there were a total of 12 terrorist related websites active. By 2003 there were approximately 2630 sites, and by January 2009 a total of 6940 active terrorist-related websites. Social media accounts platforms such as twitter have proven tremendously effective at disseminating propaganda, with data indicating that ISIS

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120 Anja Dalgaard-Nielsen, "Violent Radicalization in Europe: What We Know and What We Do Not Know." *Studies in Conflict and Terrorism* (2010): 801
accounts spread more content before getting suspended by Twitter compared with other eventually suspended accounts. In 2015 alone, there were 17 million ISIS-related tweets posted.\textsuperscript{124} Efforts to radicalize vulnerable individuals via online conduits have yielded tangible results for terrorist organizations. Once radicalized, lone wolf terrorists have deliberately targeted critical infrastructure.\textsuperscript{125}

\textit{Conclusion}

The security threat posed by terrorism has evolved from large scale, well-coordinate operations, planned, organized, and executed by formal terrorist organizations to more dispersed, less-sophisticated attacks perpetrated by ideologically motivated lone wolf terrorists. Due to inherent difficulties in identifying and monitoring lone wolf terrorists, a methodology that assists law enforcement, private sector, and government entities in recognizing relevant indicators and tendencies which differentiate lone wolf terrorists from organizational terrorists may potentially aide in the mitigation or prevention of such attacks.

While behavioral patterns and social proclivities can partly distinguish lone wolf actors from organizational terrorists, close parallels exist between the root causes of radicalization and the indoctrination process. Social isolation and political grievances lead to feelings of exclusion, which may manifest into personal grievances. Vulnerable individuals then attempt to cope with these strains by seeking to reconstruct their identity through human or virtual social networks. Their susceptibility combined with repeated exposure to radical ideology, often presented in the


form of radical propaganda, causes fundamental shifts in long established behavioral patterns. It is at this juncture that violent actions may appear as a viable method of attempting to resolve or increase exposure to perceived injustices perpetrated by society or government.

Once radicalized, lone wolf terrorists seek to identify high value targets that yield the maximum media attention, human casualties, economic and physical damage, and cause disruption to the normal functions of society. Due to the vital services and resources they provide and the impact on economic and societal functions, critical infrastructure has been identified as an optimal target for lone wolf terrorists. The proceeding section will analyze, in greater detail, the conditions that make critical infrastructure uniquely appealing and vulnerable targets for lone wolf terrorists.
II. UNDERSTANDING THE TARGET SELECTION PROCESS OF LONE WOLF TERRORISTS AND THE CORRESPONDING THREAT TO THE AVIATION SECTOR

Introduction

Is it possible to predict where terrorists will strike next? Such a task may seem improbable given that over 125,000 terrorist attacks occurred worldwide between the years of 1970 and 2013. As recent attacks indicate, terrorists have the potential to conduct operations against a seemingly endless variety of targets ranging from music festivals to military bases. However, political scientists and counterterrorism experts have devised methodologies to understand the rationale and motivations of terrorists. The strategic model, the most prevalent modeling system in this field of study, suggests that terrorists are rational actors who attack civilians for political purposes. Prior to an attack, they essentially perform an analysis to determine if the anticipated benefits outweigh the anticipated costs. This logical process helps counterterrorism forces to more effectively deploy resources in anticipation of an attack and invest in new and established mitigation technologies. The implementation of such strategies has led to a dramatic reduction of terrorist plots in the U.S. from organizations such as Al Qaeda and

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ISIS. Such efforts have also made it much more difficult for terrorist organizations to carry out large, complex attacks.129

In contrast to traditional terrorist organizations, whose methods and motivations are well publicized, researched, and tracked by state authorities, attacks by lone wolf terrorists provide the most “puzzling and unpredictable form of terrorism.”130 This is partially attributable to a lack of knowledge regarding the motivations and goals of lone wolf terrorists. Due to this lack of understanding, efforts to detect, mitigate, or prevent such attacks have proven extremely challenging, or as Edwin Bakker, professor of terrorism studies at Leiden University, states, “lone wolf terrorists are a nightmare for the counterterrorism organizations, police and intelligence communities as they are extremely difficult to stop.”131 However, like their organizational counterparts, some form of reasoning drives lone wolf terrorists. By identifying commonalities and developing corresponding methodologies to understand the thought processes of lone wolf terrorists, experts may improve their ability to predict likely targets.

This chapter proposes that due to a variety of factors, critical infrastructure (specifically the aviation sector) is likely to become the preferred target for lone wolf terrorists in democratic nations. To support this thesis, this chapter introduces three sections: (1) the literature review will examine the main schools of thought to determine if lone wolf terrorists act in a rational or irrational manner when evaluating potential targets, as well as examine other relevant aspects of the subject; (2) the results and discussion portion of this essay will introduce seven primary

131 Ibid, 46.
criteria used to determine the appeal of potential targets and how they correspond to the aviation sector, (3) the final portion contains a comparison between the aviation sector and other critical infrastructure and establishes the aviation sector’s relative target value.

**Literature Review**

**The Threat of Lone Wolf Terrorism to the Aviation Sector**

This literature review proposes that due to a variety of factors, critical infrastructure, specifically the aviation sector, is likely to become the preferred target for lone wolf terrorists in democratic nations. The literature review analyzes the behavioral tendencies of lone wolf terrorists to determine if they display rational and predictable thought processes or if their exhibited behavior is erratic. The literature review then seeks to determine if lone wolf terrorists have displayed a proclivity towards targeting specific locations, and if so, determine how their target selection criteria differs from their organizational counterparts. This information will help to analyze mitigation and prevention techniques, which may reduce mass-casualty incidents, economic disruption, and detrimental effects on continuity of operations to societal functions.

While groups such as Al-Qaeda and ISIS maintain a high public profile, a combination of military actions, intelligence operations, and various financial instruments, including seizures of funds and sanctions against nations believed to be harboring terrorists, have weakened said organizations.\(^{132}\) As a result, Al-Qaeda and ISIS have both experienced significant losses in terms of human capital, financial resources, and the amount of physical territory held under their

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control. Consequently, their ability to plan and execute major terrorist operations has diminished. Cognizant of their circumstances, terrorist organizations have shifted their focus from planning and executing major offensive operations to actively encouraging potential sympathizers worldwide to join the jihad and launch low-tech attacks against identified ideological opponents.

According to Anja Dalgaard-Nielsen the director of the Institute for Strategy at the Royal Danish Defense College, while traditional methods of social networks and in-person recruitment still represent significant contributing factors, the internet has emerged as the preeminent mechanism of radicalization. The internet provides a cathartic escape and instills a sense of community and identity for individuals who are frequently isolated and deprived. Ramon Spaaj, a research fellow at the Amsterdam School for Social Science Research, supports the correlation between feeling isolated and excluded from society and the emergence of lone wolf terrorists, stating that individuals often merge personal grievances with overarching political grievances. He concludes that potential lone wolf terrorists are more inclined to explore alternate ideologies to rationalize their state of exclusion.

Are Lone Wolf Attacks Random or Reasoned?

Logical targeting selection processes increase the likelihood that critical infrastructure locations become targets. However, before attempting to determine the most logical targets, it

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must be determined if lone wolf terrorists are actually logical. Ranya Ahmed, a research fellow at Harvard University’s FXB Center for Health and Human Rights, conducted a study of terrorist targeting patterns and asserts that ideology directly influences the deliberate selection of targets and that terrorist groups are generally perceived as rational actors that make calculations based on their objectives. This study leads Ahmed to conclude that terrorists deliberately select their targets based upon their perception and worldview.137

Conversely, Raffaello Pantucci, director of international security studies at the Royal United Services Institute, states anecdotal and non-empirical research indicates that lone wolf terrorists are random and unpredictable, with a tendency to conduct sudden or impulsive acts.138 This unpredictable behavior may be partially attributable to high degrees of mental illness. Jeff Gruenewald, an associate professor at the School of Public and Environmental Affairs at Indiana University-Purdue, found that 40 percent of lone wolf terrorists experienced some form mental illness. This constitutes a rate of occurrence that is significantly higher than the 7.6 percent mental illness rate documented amongst organizational terrorists.139 Jeffrey D. Simon, author, lecturer, and consultant on terrorism and political violence, proposes a different hypothesis to explain the random behavior displayed by lone wolf terrorists. In contrast to organizational terrorists, who must follow an established chain of command and seek approval from their

leadership, lone wolf terrorists are free from such constraints, allowing them to be creative when selecting target locations and attack modalities.\textsuperscript{140}

However, Dr. Paul Gill, a senior lecturer at University College London’s Department of Security and Crime Science, contests the notion that lone wolf terrorists primarily operate based upon impulse. Gill analyzed data sets from previous lone wolf attacks across the U.S. and other western nations, and found strong indicators that in the majority of instances, evidence of premeditation was present, including high degrees of in-person training, virtual training, and the physical possession of training materials.\textsuperscript{141} In his work, “Modus Operandi In Understanding lone wolf Terrorism,” Spaaij supports the idea that the lone wolf target selection process is logical through a series of case studies which reveals that lone wolf terrorists typically attack symbolic targets.\textsuperscript{142}

This proclivity becomes even more apparent when lone wolf terrorists conduct multiple attacks, as they often select a range of targets that possess symbolic value and belong to identified enemies, or contain individuals deemed to be adversaries. Additionally, lone wolf terrorists inspire copycat behavior and serve as motivational role models for other alienated youth, who occasionally emulate this behavioral pattern. This process displays a conscious effort to study the methodology of previous lone wolf terrorists and indicates premeditation occurs and a logical target assessment process is used.\textsuperscript{143} J.D. Mark Booher, an author, intelligence and

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\textsuperscript{140} Jeffrey D. Simon, \textit{Lone Wolf Terrorism: Understanding the Growing Threat} (Santa Monica: Prometheus Books, 2013).

\textsuperscript{141} Paul Gill, "Seven Findings on Lone-Actor Terrorists," \textit{International Center for the Study of Terrorism}, (February 6, 2013): https://sites.psu.edu/icst/2013/02/06/seven-findings-on-lone-actor-terrorists/.


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security consultant and former deputy prosecuting attorney, conducted a statistical analysis and determined that nearly one-third (29 percent), of lone wolf terrorists rehearsed “actions on the objective” or practiced dry runs of the attack. He concluded that “These statistics indicate that these attacks are planned and do not occur at random.” Peter J. Phillips, an associate professor at the University of Southern Queensland, attributes the perception that lone wolf terrorists are bolder and more aggressive than their organizational counterparts to their willingness to act. Simply put, lone wolf terrorists spend more time engaging in terrorism than their risk-averse counterparts. 

Do Lone Wolf and Organizational Terrorist Targets Differ?

Similar to traditional terrorist organizations, the primary objective for lone wolf terrorists remains the maximization of fear and intimidation to further their ideological and political goals. Utilizing the RAND-MIPT Terrorism Knowledge Data Base, Spaaij determined that the United States had more instances of lone wolf terrorism than the other 14 democratic countries analyzed in his study, including the United Kingdom, Germany, France, Spain, and Italy. This is consistent with organizational terrorist target selection patterns. Excluding nations in conflict regions and non-functional democracies, the U.S. is the nation most impacted by terrorist activity.

Brent Smith, a professor of sociology and criminal justice at the University of Arkansas, studied a variety of terrorist target locations and determined that 44 percent of group-based

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144 Mark Booher, "Lone Wolf Myths," Counter Terrorist 9, no. 6 (2016): 30-42.
147 National Consortium for the Study of Terrorism and Responses to Terrorism “Global Terrorism Database” Global Terrorism Index, June 29, 2019, http://globalterrorismindex.org/#.
attacks in the United States took place within 30 miles of terrorists' residences.\textsuperscript{148} This is consistent with other data driven analysis, which concludes that many solo terrorists do not leave their hometowns when attempting to carry out an attack. While average distances cannot reasonably predict target selections, the data indicates that proximity to a terrorist's hometown, both lone wolf and organizational, is a reasonably effective predictor of potential target areas as nearly 60 percent of the cases examined had an identifiable geographical connection to the target the terrorist eventually chose.\textsuperscript{149}

Michael Becker, a political scientist at Northeastern University, asserts that lone wolf terrorists largely select targets based on a combination of factors, including familiarity of the target and their stated political ideology. Becker determined that the majority of lone wolf attacks focus on civilian targets; government targets were the second most common target and military targets only accounted for around seven percent of attacks.\textsuperscript{150} Spaaij also determined that lone wolf terrorists primarily target civilians, as 58 percent of attacks have identified civilian targets as opposed to other identified enemies such as military personnel or government representatives.\textsuperscript{151} Pantucci confirms both Becker’s and Spaaij’s findings, but adds that in addition to targeting civilians, lone wolf terrorists have displayed an increasing tendency to intentionally target law enforcement personnel. Lone wolf terrorists killed or wounded 12 law enforcement officers in the 60 years preceding 9/11. This figure quadrupled in the first 16 years

\begin{footnotesize}
\begin{enumerate}
\item \textsuperscript{149} Charles A. Eby, \textit{The Nation that Cried lone wolf: A Data-Driven Analysis of Individual Terrorists in the United States since 9/11 thesis}, (Montery, CA: Naval Postgraduate School, 2012)
\end{enumerate}
\end{footnotesize}
following 9/11.\textsuperscript{152} Dr. Max Abrahms, an associate professor of political science at Northeastern University contributes nuance to the argument by analyzing terrorist organizations’ target selection and concludes that although all terrorist groups occasionally harm civilians, these groups are highly motivated by ideology. This ideology drives certain groups to target civilians more frequently than others.\textsuperscript{153}

**Is the Aviation Sector a Desirable Target?**

Political scientist, Dr. Joshua Sinai, proposes that for terrorists who are “determined to kill indiscriminately and to inflict mass casualties, economic disruption, obtain world headlines, and psychological anxiety and fear among wider publics, aviation transportation in the form of commercial airports and airplanes are ideal targets.”\textsuperscript{154} James M. Ludes, the executive director of the Pell Center for International Relations and Public Policy at Salve Regina University, indicates that these motivations are consistent with the target pattern of Al-Qaeda. Ludes elaborates by stating Al-Qaeda has identified ideal targets as those that provide high media visibility, serve a vital economic function, cause maximum disruption to societal functions, provide the potential for mass casualties, and inflict the greatest psychological fear possible.\textsuperscript{155}

In respect to economic impact, Peter Gordon, professor emeritus at the University of Southern California Price School of Public Policy, projected a seven-day shutdown of the entire

\textsuperscript{152} Raffaello Pantucci, *A Typology of Lone Wolves: Preliminary Analysis of Lone Islamist Terrorists* (London: The International Centre for the Study of Radicalisation and Political Violence, 2011)


U.S. commercial air transportation system, followed by a two-year period of recovery, using the post September 11 experience. Overall loss estimates for the two years range from $214 billion to $420 billion.\textsuperscript{156} To support the validity of this type of attack occurring, Dr. Sinai concludes that based on previous attack history, Israeli airliners are the top targets followed by U.S. airliners. In respect to aircraft assaults, the data indicates that terrorists tend to target larger aircraft as opposed to smaller planes.\textsuperscript{157} However, operating with minimal resources and training, lone wolf terrorists have favored soft targets that are susceptible to low-tech, non-resource intensive attacks, indicating that aircraft assaults are not a probable modality for lone wolf terrorists.\textsuperscript{158} Dr. Sinai found that simple active shooter attacks in public areas such as ticketing or baggage claims are likely to produce mass casualties and generate mass media coverage.\textsuperscript{159} This is consistent with recent, similar attacks, most notably the Brussels Airport attack in 2016, and the Fort Lauderdale-Hollywood International Airport in January 2017.\textsuperscript{160}

**Gaps in Analysis**

While there is adequate research available to help understand the organizational terrorist target selection process, such research regarding the lone wolf terrorist target selection criteria is


\textsuperscript{158} Jeffrey D. Simon, \textit{Lone Wolf Terrorism:Understanding the Growing Threat} (Santa Monica: Prometheus Books, 2013).


not as comprehensive and conclusive. Since lone wolf terrorist attacks are generally premeditated, critical analysis is required to predict their likely targets.

Traditional terrorist target selection models operate on four core assumptions. These include: (1) a desire for said terrorist organization to cause damage to a nation’s political capacity, economic capacity, and demography; (2) that terrorist organizations seek to compel a nation to make concessions or act according to their demands, (3) terrorists have limited resources to utilize in their missions, (4) terrorists will select targets that optimize their scarce resources.

James F. Miskel, a consultant and adjunct professor at the Naval War College, largely supports this target selection criterion. He argues that terrorists evaluate potential targets based upon the potential to inflict casualties, economic damage, and destruction of public infrastructure. These assumptions will need to be supported by future research to confirm the validity and usefulness in predictive models.

**Results and Discussion**

The preponderance of information articulated in the preceding literature review indicates that lone wolf terrorists typically follow a similar behavioral pattern to their organizational counterparts, meaning that although variance exists based upon factors such as ideology and mental health, lone wolf terrorists generally display a reasoned and logical target selection process. In his influential report, “Assessing Terrorist Motivations for Attacking Critical Infrastructure,” Professor Ackerman, of New York State University, Albany, identifies and

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analyzes primary motivating factors for the terrorist target identification and selection process. This essay will analyze seven of Ackerman’s criteria including: (1) casualties, (2) target value, (3) symbolic value, (4) economic impact, (5) psychological impact, (6) influence of similar attacks, and (7) interconnectedness. The results of this analysis will determine the severity of the threat that lone wolf terrorists pose to the aviation sector, and if the aviation sector is likely to become the most desirable critical infrastructure target for lone wolf terrorists.

Casualties

Historically, terrorists tend to favor the “path of least resistance.”¹⁶³ Paradoxically, terrorists have conducted a large number of attacks against airports: targets with relatively high levels of security. Perhaps this is due to the high casualty potential which Hoffman identified as a primary motivator for terrorists when evaluating a potential target.¹⁶⁴

Between 1931 and 2016, 635 attacks against the aviation sector occurred from both lone wolf and organizational terrorists, worldwide. Exactly 460 (72 percent) of those attacks resulted in no casualties.¹⁶⁵ The remaining 175 (28 percent) of said attacks proved to be extremely deadly, resulting in 6,184 fatalities.¹⁶⁶ This lethality rate is considerably higher than terrorist attacks against other critical infrastructure. For example, in the U.S., between 1970 and 2015, approximately 90 percent of all attacks that targeted critical infrastructure were non-lethal.¹⁶⁷

¹⁶⁶ Ibid, 334.
the same period, the commercial facilities sector suffered the highest number of attacks, 454, causing just 39 total deaths.\textsuperscript{168}

Terrorists specifically targeted airports 232 times between 1931 and 2016, causing 468 deaths.\textsuperscript{169} Recent trends indicate that the severity of attacks is increasing, with 2016 being the most lethal year on record for terrorist attacks against airports.\textsuperscript{170} Those attacks resulted in 62 deaths which are attributable to the attacks conducted at Brussels Airport on March 22, resulting in 16 deaths,\textsuperscript{171} and at Atatürk Airport in Istanbul on June 28, resulting in 46 deaths.\textsuperscript{172} This increased trend in lethality is consistent with data analyzing lone wolf attacks on a variety of targets. From 1940 through 2000, the pre-9/11 era, 39 lone wolf terrorists committed 173 attacks, resulting in 100 fatalities and injuring another 305 people. From 2001 through mid-2016, 69 lone wolf terrorists committed 147 attacks, killing 156 people and injuring 184 people.\textsuperscript{173}

Airport designs focus on utility and aesthetic appeal as opposed to creating optimal security environments. Airports typically feature large, readily accessible public areas in which high volumes of passengers congregate around relatively confined and vulnerable areas. Unless airports are willing to incur the cost associated with retrofitting airport designs to segregate

\textsuperscript{168} Ibid, 8.
\textsuperscript{170} Ibid, 347.
\textsuperscript{173} Mark Hamm and Ramón Spaaij, The Age of Lone Wolf Terrorism (New York: Columbia University Press, 2017).
passengers and reduce the total number of potential victims, airports will continue to provide ample targets as well as the potential for high casualty attacks for the near future.

**Target Value**

The function of a particular target influences terrorists’ target selection process. Terrorists prefer targets with a high public profile, and they will consciously select such targets as opposed to targets with similar characteristics but a lower public profile. When evaluating the target value of airports, terrorists may conclude that they provide both a highly visible public profile and high utility. In 2013, the approximate passenger volume on commercial flights exceeded 3.1 billion passengers, and airfreight services transported an estimated 50 million tons of cargo, with an annual value of approximately $6.4 trillion or 35 percent of the value of goods traded internationally. Due to the growing number of passengers and cargo, both the utility and profile of airports are consistently increasing. Any damage to these locations has the potential to cause significant disruption to their utility, while simultaneously generating vast media coverage, making it likely that the target value will remain a significant variable in the future.

**Symbolic Value**

Similar to how 10 Downing Street or the White House represents freedoms associated with Western democracies, airports are representative of globalization, modernity, and the freedom of movement. Ackerman asserts that an attack against a critical infrastructure facility with a high symbolic value is more probable than a critical infrastructure facility with high utility.

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but less symbolic value.\textsuperscript{177} In the instance of airports, such facilities provide a high symbolic value, serving as the port of entry for numerous travelers, are internationally identifiable, and as previously discussed, provide a high utility in both the commercial and transportation sectors.

The allure of attacking American airports may be inherently more appealing to foreign-based terrorists, as they may perceive attacks against high profile U.S. targets as being tantamount to an attack against U.S. expansionism, imperialism, or economic exploitation.\textsuperscript{178} This is consistent with lone wolf targeting proclivities. The United States was the most-targeted country by lone wolf terrorists, accounting for 63 percent of all attacks (46 attacks). The second most-targeted nation was the United Kingdom with 10 attacks followed by Germany with five attacks.\textsuperscript{179}

Symbolism is also a determining factor when selecting public sector vs private sector infrastructure targets as well as human targets. Of the lone wolf terrorists studied by Becker, approximately 60 percent chose civilian targets, while government targets were selected approximately 32 percent of the time. Military targets only accounted for around seven percent of attacks.\textsuperscript{180} With respect to human targets, lone wolf terrorists have increasingly targeted law enforcement personnel. Lone wolf terrorists killed or wounded 12 law enforcement officers in the 60 years preceding 9/11. This figure quadrupled in the first 16 years following 9/11, when the

\begin{itemize}
\item[\textsuperscript{177}] Gary Ackerman, \textit{Assessing Terrorist Motivations for Attacking Critical Infrastructure} (Livermore: Lawrence Livermore National Laboratory, 2007): 47.
\item[\textsuperscript{179}] Raffaello Pantucci, \textit{A Typology of Lone Wolves: Preliminary Analysis of Lone Islamist Terrorists} (London: The International Centre for the Study of Radicalisation and Political Violence, 2011)
\end{itemize}
number of law enforcement personnel killed or wounded by lone wolf terrorists rose to 50. The majority of these attacks occurred between 2009 and 2015.\textsuperscript{181}

The symbolic value of a target is dependent upon identifiable attributes including, but not limited to, known landmarks, historical significance, functionality, and location. However, ideologically motivated terrorists may elect to value certain targets more or less than their non-ideological counterparts. In regard to ideological motivation, lone wolf attackers were comprised of 17 percent rightwing racists, 15 percent Islamists, eight percent anti-abortion extremists, and seven percent national-separatists. The remaining attackers’ motivations were classified as unknown.\textsuperscript{182}

The symbolic value of airports is subject to change. If Western nations elect to alter some of the more controversial foreign policies, this may diminish the sense of urgency that certain ideologically motivated terrorists espouse when attempting to stop what they perceive as imperialist expansionism or government overreach. Additionally, other highly identifiable targets may emerge to take the place of airports, making them appear less valuable from the terrorists’ perspective. However, historical trends and the inherent visibility of airports, combined with being government facilities that contain both civilian and law enforcement targets, make it likely that airports will remain a desirable symbolic target. This status is unlikely to diminish even if additional high value targets emerge over time.

\textsuperscript{181} Mark Hamm and Ramón Spaaij, \textit{The Age of Lone Wolf Terrorism} (New York: Columbia University Press, 2017).
\textsuperscript{182} Petter Nesser, "Research Note: Single Actor Terrorism: Scope, Characteristics and Explanations," \textit{Perspectives on Terrorism} 6, no.6 (2012): 61-70.
Economic Impact

Attacks on aviation-related infrastructure have the potential to inflict significant economic damage to both domestic and international economies. As a point of reference, the March 22, 2016 ISIS attack on Brussels International Airport is estimated to have cost Belgium approximately $4.47 billion in lost revenue due to the closures of services such as transport, hospitality, and other businesses. Projections indicate that an attack on a major U.S. airport will have an even greater economic impact. Based upon a simulated terrorist attack on a U.S. airport and on a domestic airliner, the estimated impact on GDP exceeds $10 billion. These results indicate that consumer behavioral patterns change during major terrorist events. Experts anticipate that an attack against a major U.S. airliner will alter consumer behavior at nearly an order of magnitude higher than the ordinary business interruption and nearly two orders of magnitude higher for the airport attack, indicating that the instability resulting from terrorist activity against the aviation sector reduces the volume of tourism, travel, and related commerce. A survey of U.S. based firms found that immediately following the 9/11 attacks, over 75 percent of firms surveyed allowed employees to cancel or postpone business trips and 45 percent of firms cancelled events or meetings while 56 percent tightened internal security measures, including increased vetting of employees. This data corresponds with organizational propaganda efforts, encouraging lone wolf attacks against the aviation sector. The 2014 winter

185 Ibid, 1403.
issue of Inspire, an English-language online magazine edited by Al-Qeda, called for lone wolf terror attacks against a number of major airlines, specifically stating that bombs should be detonated on the planes of several preeminent US commercial airline companies, including American Airlines, Delta, United, and Continental, in an effort to gain publicity and “crush the enemy’s economy.”

As experienced in actual incidents, and estimated in financial projections, attacks against airports are extremely costly on local, regional, and national levels as disruptions to the global economy causes ripple effects that are felt in related industries such as ground transportation, hospitality, and tourism. As globalization and the dependency on the transportation sector increases, the economic vulnerability posed by disruptions to airport services will magnify, making this an increasingly desirable criteria for terrorists when evaluating attacks against the aviation sector.

Psychological Impact

The Terrorism Act of 2000 defines terrorism as “the use or threat of action where the use or threat is designed to influence the government or to intimidate the public or a section of the public, and the use or threat is made for the purpose of advancing a political, religious, or ideological cause.” Not only have attacks against the aviation sector influenced or augmented the behavior of the public, but attacks have also inflicted considerable mental and emotional damage. A study assessing the psychological impact of the 9/11 attacks determined that the

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incidence of post-traumatic stress disorder (PTSD) was at 40 percent locally (around Manhattan). Nationally, the prevalence of PTSD symptoms varied between 7.5 and 20 percent.\textsuperscript{189} Nationally, an estimated 60 percent of the population experienced symptoms of depression, while findings pertaining to the incidence of substance abuse following the attacks were inconclusive.\textsuperscript{190} Social media platforms have made it easier to rapidly disseminate graphic images of physical destruction and other traumatic visual, auditory, and written inputs. This has made attacks against the aviation sector even more potent, as these inputs are likely to be seen and heard by more people, and subsequently cause greater psychological damage.

\textbf{Influence of Similar Attacks}

Every new terrorist generation learns from its predecessors.\textsuperscript{191} A group’s ability to learn is directly commiserate with its chance of operational success.\textsuperscript{192} Similar to organizational terrorists, lone wolf terrorists learn and emulate the behavior displayed by their predecessors in successful attacks. They often deliberately elect to bypass hardened targets in favor of soft targets.\textsuperscript{193} This means that a desire for operational success partially motivates lone wolf terrorists as they evaluate potential targets.\textsuperscript{194}

Current or aspiring terrorists have witnessed numerous successful attacks against the aviation sector, most notably 9/11. More recent attacks against the sector have been experienced

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doi:10.1080/19434470903319474.
\textsuperscript{190} Ibid, 39-40.
\textsuperscript{192} Brian Jackson, \textit{Aptitude for Destruction, Volume 2} (Santa Monica: RAND Corporation, 2005), 97-103.
\textsuperscript{193} Jeffrey D. Simon, \textit{Lone Wolf Terrorism: Understanding the Growing Threat} (Santa Monica: Prometheus Books, 2013).
\end{flushright}
in the Brussels Airport and Atatürk Airport attacks. Such attacks have generated high casualties, substantial economic damage, and in the case of 9/11, unprecedented media exposure. These successes partially account for why the aviation sector has been repeatedly targeted, as other terrorists seek to emulate those behavioral patterns and experience similar accomplishments.

Unless airports elect to enhance security measures and said measures effectively and repeatedly thwart terrorist attempts to strike these facilities, others will emulate the behavior. Of all the selection criteria established thus far, this variable has the greatest potential to make airport attacks less desirable. By establishing and publicizing precedent cases in which security measures defeat terrorist efforts, security officials can force terrorists to reevaluate the likelihood of achieving operational success.

**Interconnectedness**

Advances in technology, specifically communication, commerce, and travel, have led to interdependencies in the global economy and international supply chains. These interdependencies have made society increasingly more vulnerable to terrorism.\(^\text{195}\) Disruptions to modern interconnectivity can manifest in various forms. In the context of potential ramifications of airport attacks, the range is broad. On an individual level, increased security restrictions generally result in delays.\(^\text{196}\) With respect to commercial disruptions, 34 percent of respondents from a diverse range of major industries such as manufacturing, utilities, construction, and

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wholesale trades reported they had experienced a disruption in their supply chain due to 9/11.\textsuperscript{197} Attacks of a higher magnitude have the potential to cause catastrophic damage to infrastructure and prompt the implementation of more restrictive changes to long-term security practices. The appeal of causing disruptions to societal interconnectivity has historically been a key motivator for terrorist attacks as globalization continues to proliferate; security forces should anticipate that this factor would be of great importance to terrorists.

Ackerman divides attack types into four categories: attacks directed towards harming people, those that threaten to harm people, those intended to destroy infrastructure, and those intended to disrupt infrastructure for a limited amount of time.\textsuperscript{198} These attack types serve to establish the sequence of criteria beginning with the most impactful factors and continuing in diminishing order. As referenced in the literature review, other experts in the field have identified and argued the significance of these criteria, which represent a wide spectrum of motivations. However, it is important to note that terrorist motivations may not be limited only to the criteria listed above.

\textbf{The Value of the Aviation Sector over Other Targets}

Having established that the aviation sector fulfills all seven of the target selection criteria, other critical infrastructure targets will theoretically need to fulfill a comparable number of criteria, or substantially exceed the results obtained by potential aviation sector attacks in order to achieve similar target desirability. Terrorist targeting preferences change based on perceived

\begin{flushleft}
\textsuperscript{197} Sang M. Lee and Marijane E. Hancock, "Disruption in Supply Chain Due to September 11, 2001." \textit{Decision Line} (2005): 9-10. \\
\textsuperscript{198} Gary Ackerman, \textit{Assessing Terrorist Motivations for Attacking Critical Infrastructure} (Livermore: Lawrence Livermore National Laboratory, 2007): 47.
\end{flushleft}
vulnerabilities, accessibility to the target, availability of weaponry, and the social milieu of the era. For example, soft targets such as oil pipelines, have recently experienced an exponential increase in attacks. In the 1990s, 1508 attacks against energy infrastructure were recorded worldwide. In the 2000s, 4223 events were recorded, more than doubling the total number of attacks in the previous decade.\footnote{Charlinda Santifort, Todd Sandler and Patrick Brandt, "Terrorist attack and target diversity: Changepoints and their drivers." \textit{Charlinda Santifort, Todd Sandler and Patrick T Brandt} (Sage Publications, Ltd.) 50 (2013): 83. https://www.jstor.org/stable/pdf/23441158.pdf?refreqid=searchpercent3Ab1c71b3968991ba33ca7ab5233a504d7.} Conversely, in the 1970s, a series of terrorist attacks against various embassies around the world prompted the U.S. government to enhance security at their embassies beginning in 1976. These security enhancements effectively decreased the number of attacks, but also caused terrorists to shift their focus to other, more vulnerable targets.\footnote{Jennifer Giroux, Peter Burgherr and Laura Melkumaite, "Research Note on the Energy Infrastructure Attack Database (EIAD)." \textit{Perspectives on Terrorism (Terrorism Research Institute)} 7 (2013): 119.} Despite the dramatic increase of pipeline attacks, it is unlikely that they will emerge as lone wolf terrorists target of choice as they fail to meet numerous criteria, including possessing symbolic value, failing to inflict serious psychological impact, and having limited casualty potential. Conversely, other targets, such as military bases, embassies, and other critical government installations meet many of the established criteria but are heavily fortified and reduce the probability of success. Thus, targets need to meet a combination of desirability and feasibility.

Attacks against other transportation infrastructure, such as passenger trains, have yielded media attention, varying degrees of psychological trauma, and high casualty rates. The 2004 Madrid train attacks killed 191 people and wounded 1800. In London, 2005, 52 people died and around 700 were injured. In Russia, the attack on the Nevski express killed 27 people. In the
Moscow Metro attack, 39 people died and 70 were injured. However, despite being effective, relatively low resource intensive attacks, they did not meet several of the established criteria, including possessing symbolic value, as train stations may pose varying degrees of symbolic value. Trains themselves are routinely decommissioned as they age and are easily replaced when physical damage occurs. Since trains operate on fixed rails, the destructive capability is limited to a predefined path. Conversely, aircraft have the ability to attack any number of physical targets, as experienced in 9/11. Additionally, these attacks had limited economic impact and possessed a limited target value. While trains are visible targets, there are ample travel alternatives including cars, buses, and air travel with air travel being inherently more efficient for long distance journeys.

Even complex, simultaneous attacks against multiple infrastructure targets do not have the impact that potential aviation sector attacks have. For example, the 2008 Mumbai attacks by Lashkar-e-Toiba targeted Cama Hospital, Chhatrapati Shivaji Railway Terminus, and numerous police officers, using a combination of explosives and firearms. These attacks were very effective, resulting in over 300 casualties. Despite obtaining high volumes of media attention, possessing symbolic value, utility, and inflicting psychological trauma “the impact of the Mumbai attacks on the economy and business sectors was limited.”

The key affected industries were tourism, hospitality, and airlines. However, the most significant impacts were on the

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202 Angel Rabasa, Robert Blackwill and Peter Chalk, *The Lessons of Mumbai* (Santa Monica: Rand Corporation, 2009)


204 Arabinda Acharya, *Terrorist Attacks in Mumbai: Picking Up the Pieces* (Singapore: International Centre for Political Violence and Terrorism, 2009)
business travel and tourism. The Association of Corporate Travel Executives surveyed 134 corporate travel managers after the Mumbai attacks and found that just six percent planned to curtail travel to the region. In 2008, India's GDP was approximately one trillion dollars, with tourism contributing just more than 10 billion dollars. Thus, the impact of even a major slowdown would be minor.²⁰⁵

While other critical infrastructure targets have varying degrees of desirability, it appears none of the infrastructure discussed in this section hold the same target desirability as the aviation sector, based upon the established terrorist targeting criteria. Further analysis of each critical infrastructure sector is required to determine which, if any, match the desirability of the aviation sector.

**Conclusion**

Complex emotions and perceived grievances often influence potential terrorists. These motivations make it difficult to predict which targets they will find desirable. Although the actions of lone actor and organizational terrorists produce similar outcomes, namely attacking targets that they determine to be desirable, the rationale utilized to reach said conclusion can differ significantly. Despite a wide range of variables such as contrasting political objectives, radical interpretations of religious ideology, and the threats posed by evolving security environments, commonalties exist between organizational and lone wolf terrorists. Establishing that lone wolf terrorists frequently behave as rational actors in respect to their target selection process, political scientists and counter terrorism officials can employ various methodologies to determine which criteria lone wolf terrorists find desirable when evaluating potential targets.

²⁰⁵ Ibid, 34-36.
Understanding and analyzing the targeting criteria can help experts perform vulnerability assessments of existing facilities to determine which infrastructure targets are at greater risk.

While other critical infrastructure targets have components of the target selection criteria discussed in this work, the aviation sector possesses a unique combination of attributes that meets all establish target criteria. In addition, attacks against the aviation sector have profound societal impact, and the probability of success is high despite limited resources controlled by lone wolf terrorists. These factors make the aviation sector a highly desirable target for lone wolf actors. Simply put, the aviation sector provides terrorists with the most “bang for their buck”\textsuperscript{206} when compared to other critical infrastructure targets.

Having established the desirability of the aviation sector as a target and the potential impact that a major disruption to the sector causes to the global economy and psychological well-being of the public, a comprehensive analysis of possible lone wolf terrorist attack modalities is required to determine the sector’s vulnerabilities. While determined individuals will continue to innovate and seek to attack vulnerable targets, this assessment will enable aviation security personnel to identify potential weaknesses and create countermeasures designed to detect, mitigate, and prevent future attacks.

\textsuperscript{206} Gary Ackerman, \textit{Assessing Terrorist Motivations for Attacking Critical Infrastructure} (Livermore: Lawerence Livermore National Labratory, 2007): 44.
III. MITIGATING POTENTIAL TERRORIST ATTACKS AGAINST THE AVIATION SECTOR

Introduction

Is it possible to secure airports and other aviation-related infrastructure from potential terrorist attacks? Results indicate that many of the security measures currently implemented have not proven effective at preventing attacks.\(^{207}\) Furthermore, terrorists are actively seeking new targets in the aviation sector.\(^{208}\) The desire to conduct such attacks is understandable, as previous attacks have resulted in mass casualties, substantial disruptions to societal functions, and significant economic loss.\(^{209}\) Preventing aviation sector terrorist attacks requires an understanding of terrorists’ capabilities, government counterterrorism initiatives, and extensive human and physical security resources dedicated to identifying and defeating terrorist threats.

Having previously established that the degradation of terrorist organizations has led to the proliferation of lone wolf terrorists and that critical infrastructure, specifically the aviation sector, represents the most desirable target for lone wolf terrorists, this section will determine: (1) the most likely methods terrorists will use to attack the aviation sector, (2) potential mitigation and prevention techniques, and (3) if government policies and programs designed to prevent the radicalization of potential terrorists, or de-radicalize existing terrorists, have potential to reduce the terrorist population. This chapter will conclude by conducting an evaluation to determine the


feasibility of securing airports and other aviation-related infrastructure from terrorist attacks using physical security measures and counterterrorism policies.

**Literature Review**

**Attack Modalities and Mitigation Techniques**

Having established that the aviation sector represents a highly desirable target for lone wolf terrorists, security officials must take practical measures to mitigate this threat. This process requires a comprehensive understanding of the most likely attack modalities used by lone wolf terrorists and corresponding mitigation technologies. This literature review: (1) establishes the most likely attack modalities used by lone wolf terrorists, (2) examines if existing physical security measures can effectively prevent terrorist attacks, and (3) seeks to determine if governments can preemptively disrupt future terrorist attacks by reducing the terrorist population using counter violent radicalization programs.

**Attack Modalities**

Former Georgetown University professor, Walter Laqueur, proposes that lone wolf terrorists are amongst the likeliest to conduct a WMD attack.\(^{210}\) However, the practicality of terrorist organizations acquiring the precursory materials to develop WMD, which are generally classified as one of chemical, biological, radiological, nuclear, or explosive has been presented as difficult, and even unlikely, by renowned Georgetown University Professor Bruce Hoffman.\(^{211}\) Further analysis reveals that even if terrorists were able to acquire the raw materials, 

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Considerable technical challenges may prevent the creation of a WMD. The transport, 
deployment, and dispersal of WMD presents another daunting technical challenge that exceeds 
the capabilities of many terrorist organizations and lone wolf terrorists.\textsuperscript{212}

Raffaello Pantucci, the director of international security studies at the Royal United 
Services Institutes, conducted a practical assessment of attack modalities, which indicated that 
lone wolf terrorists elected to plan their attacks, procure their weaponry (often firearms) and 
automously execute attacks that are realistic and executable.\textsuperscript{213} However, increased regulations 
have made the acquisition of bombmaking materials considerably more difficult. It appears that 
the combination of increased difficulty in acquiring requisite explosive materials, in conjunction 
with the relaxation of U.S. gun laws, has resulted in firearms becoming the preferred weapon of 
lone wolf terrorists.\textsuperscript{214} Clive Williams, an associate professor at the Australian Defense Force 
Academy, supports this finding with his statistical analysis of lone wolf terrorists attack 
modalities. He finds that lone wolf terrorists overwhelmingly utilize firearms in attacks. This is 
in contrast to terrorist organizations, which utilize bombings and firebombings far more 
frequently, constituting the most common form of terrorist incident and accounting annually for 
65–75 percent of all international terrorist attacks.\textsuperscript{215}

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\textsuperscript{212} Benjamin Cole, Nadine Gurr and Benjamin. \textit{The New Face of Terrorism: Threats from Weapons of Mass 
\textsuperscript{213} Raffaello Pantucci, \textit{A Typology of Lone Wolves: Preliminary Analysis of Lone Islamist Terrorists} (London: 
The International Centre for the Study of Radicalisation and Political Violence, 2011)
\textsuperscript{214} Ibid, 6.
\end{flushleft}
Physical Mitigation

Can police and other security personnel mitigate terrorist attacks? The attacks on 9/11 resulted in increased airport security measures. The Aviation Transportation and Security Act signed November 19, 2001, requires that all baggage carried aboard commercial aircraft is screened. To facilitate this screening process, in 2017, 7.6 billion dollars was budgeted for the TSA, including funds to purchase screening technology, hire and train TSA and other security screening personnel.²¹⁶

According to TSA reports the security screening process has proven to be effective. In 2015, TSA personnel screened more than 708 million passengers and screened approximately 1.6 billion carry-on bags, 432 million checked items, and 12.9 million airport employees, reducing the possibility of insider threats. TSA personnel discovered 2,653 firearms in carry-on bags within 236 airports. Of those discovered, 83 percent were loaded. Along with firearms, TSA confiscated other dangerous devices, such as grenades, gunpowder, ammunition, knives, and other prohibited items.²¹⁷ However, despite the compelling statistics, some experts question the effectiveness of existing aviation security programs.

Gerald L. Dillingham, director of civil aviation issues at the U.S. Government Accountability Office, contends that, due to substandard compensation, the security workforce has experienced high attrition rates (exceeding over 100 percent a year at most large airports), making it difficult to staff adequately trained personnel. Because of a fatigued and undertrained


workforce, screeners have missed up to 20 percent of the potentially dangerous objects used by FAA in its tests. Jennifer A. Grover, director of Homeland Security and Justice, expands upon Dillingham’s argument. Grover provides further analysis of the detection process, stating the Government Accountability Office found no scientific evidence that TSA Behavioral Detection Officers (BDOs), who are trained to detect unusual behavior in screening lines, are capable of “reliably and effectively identifying high-risk passengers who may pose a threat to the U.S. aviation system.” While data suggests that the TSA screening process has yielded tangible results, the testing process has revealed significant flaws, limiting its effectiveness.

Aaron J. Chalfin, assistant professor of criminology at the University of Pennsylvania, analyzed the effectiveness of law enforcement deterrents and found that “there is robust evidence that crime responds to increases in police manpower and to many varieties of police deployments.” Chalfin references previous studies and determines that law enforcement deployments focused on deterrents efforts have, in some cases, “led to remarkably large decreases in offending.” Chalfin’s findings are consistent with other studies indicating that a police presence deters various forms of crime, including terrorism. However, security officials must determine if a high deployment strategy is the most effective use of resources to protect the aviation sector against potential terrorist attacks.

221 Ibid, 37.
Professor Mark G. Stewart, of the University of Newcastle in New South Wales, conducted a cost-benefit assessment of the Federal Air Marshal program and determined that the measurable effects in crime reduction do not justify the expenditure in maintaining the Air Marshal program. Stewart elaborates, stating that even though FAMS does reduce risk, “virtually all of that benefit can be obtained with a less expensive mix of security measures.”

These measures include the installation of physical secondary barriers to prevent entering the cockpit and doubling the budget of the Federal Flight Deck Officer (FFDO) Program, which allows pilots and crewmembers to carry firearms to defend the flight deck.

Professor Jon Coaffee, from the Department of Politics and International Studies at the University of Warwick, proposes that the developing pre-emptive solutions design of structures can embed a greater degree of resilience into both the physical design of structures and the associated management systems. Coaffee references the security benefits of incorporating blast resistant materials and physical barriers such as bollards to both prevent and mitigate attacks. However, Coaffee acknowledges incorporating such physical design features into structures can add significant expense and may be perceived as visually unpleasing to the public. Thus, designers must focus on aesthetics and security simultaneously, seeking to create a stealth security environment.

In addition to physical security, detection mechanisms have proven valuable in counterterrorism efforts. Professor Gabriel Nowacki, of the Military University of Technology in

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224 Ibid.
Warsaw, Poland, examined the use of artificial intelligence combined with CCTV systems. Nowacki determined that the use of CCTV systems, in conjunction with advanced behavioral analytics software, can identify and analyze facial expressions and other forms of suspicious behaviors. Such systems are capable of alerting specialized security officials so that they may investigate and potentially intervene.\textsuperscript{226}

\textbf{Counter-Radicalization Programs}

While technologies assist in deterring and mitigating potential terrorist attacks, programs designed to prevent the radicalization of vulnerable individuals may help to reduce the aggregate number of attacks by reducing the population of terrorists themselves. In this field, there are two prevalent schools of thought: (1) radicalization prevention programs, and (2) de-radicalization programs.

Dr. Lorenzo Vidino, the director of the Program on Extremism at George Washington University, contends that radicalization prevention programs have the potential to reduce potential terrorists by focusing on community engagement, including targeted interventions with individuals who have radicalized but have not yet mobilized to violence. However, such programs in the U.S. face numerous obstacles, including a lack of funding, a lack of a lead agency responsible for the administration and application of said programs, and resistance from the Muslim community, whose members are often targeted for interventions.\textsuperscript{227}


In contrast, Dr. Chris Allen, a lecturer in the School of Social Policy at the University of Birmingham, contests that radicalization prevention programs have had the inadvertent effect of harassing and alienating members of minority communities. Allen states that since police departments are often responsible for administering radicalization prevention programs and focus on members of the Muslim community, they have the potential for serious and detrimental social impacts. The negative interactions between police officers and community members may essentially end up doing more harm than good.  

Professor Isabella Pistone, from the Department of Philosophy at the University of Gothenburg, conducted an analysis of various counter-violent extremism programs from around the world and concluded that there is a lack of evidence to determine the effectiveness of such programs. This lack of evidence creates a gap in the knowledge and makes it difficult to determine if counter-violent extremism programs are beneficial, detrimental, or have no impact. Pistone implies that there is a great need for empirical investigations evaluating the comparative effectiveness of intervention outcomes in order to ensure that policymakers and practitioners can base their decisions on an adequate knowledge base.

Furthermore, an analysis of several of the most prominent online deradicalization programs implemented in Western countries, including Australia, Canada, and the United States, concluded that such programs are primarily directed toward countering jihadist violence. One endeavor, EXIT White Power (EWP), focuses on white nationalist and white supremacist

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extremism. This is despite white supremacist ideology inspiring the greatest number of lone wolf terrorists in the United States. This implies that, in some nations, a reprioritization of resources and effort may be required to address the most probable threats from lone wolf terrorists.

**Results and Discussion**

Terrorists employ a wide variety of weapons and attack modalities for the furtherance of accomplishing their operational objectives. The aviation sector has proven vulnerable to many common methods of attack, including shootings, stabbings, bombings, and vehicular ramming. Before recommending potential mitigation techniques and technologies, the most common attack modalities must be determined.

**Attack Modalities - Weapons Selection**

The Global Terrorism Database lists 50,427 terrorist attacks that identify the attack modality. Of these attacks, 48,405 used a firearm or bomb, accounting for approximately 96 percent of said attacks. This selection process indicates a preference for proven and easily obtainable types of weaponry. Recent trends support this notion. Data indicates that terrorists, especially lone wolf terrorists, are increasingly utilizing vehicular ramming attacks.

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233 Ibid, 1191-1192.
The use of explosives in the form of IEDs has proven to be an effective method of attack in various environments. While only three percent of terrorist attacks involve suicide bombers, they are responsible for 48 percent of all improvised explosive device related casualties.\textsuperscript{234} On average, each explosive device that detonates kills 16.3 people, 12.5 times more than the 1.3 people killed by the use of other type of weaponry.\textsuperscript{235}

Prior to 9/11, the weapons preference of lone-wolf terrorists closely resembled that of organizational terrorists, meaning that bombings were the primary attack modality. In the U.S., bombing attacks prior to 9/11 accounted for 234 victims. In 1971 and 1972 alone, the FBI reported more than 2,500 domestic terrorism bombings.\textsuperscript{236} However, due to more stringent government regulations preventing the acquisition of precursor materials, the use of explosive devices has substantially decreased. Since 9/11, there have been only six victims of lone wolf bombings in the United States.\textsuperscript{237} Consequently, firearms have become the preferred method of attack for lone wolf terrorists in both the U.S. and Europe. In Europe, firearm attacks accounted for 37 percent of all attacks, followed by explosives, accounting for 20 percent of all attacks.\textsuperscript{238} Professor Peter Nesser conducted a study of numerous Western democratic nations and found that lone wolf terrorists used firearms in 43 percent of attacks and explosives in 28 percent of

\textsuperscript{234} Ross Johnson, \textit{Antiterrorism and Threat Response} (Boca Raton: Taylor & Francis Group, 2013)
\textsuperscript{235} Brian Jenkins and Bruce R. Butterworth, \textit{Troubling Trends in Terrorism and Attacks on Surface Transportation: The Outlook Is Grim, but People Still Have a Great Deal of Control} (San Jose: Mineta Transportation Institute Publications, 2015): 3.
\textsuperscript{236} Mark Hamm and Ramón Spaaij, \textit{The Age of Lone Wolf Terrorism} (New York: Columbia University Press, 2017).
\textsuperscript{237} Ibid, 6.
attacks; armed hijackings accounted for 16 percent of all attacks, and six percent of attackers committed arson.\footnote{Petter Nesser, "Research Note: Single Actor Terrorism: Scope, Characteristics and Explanations," \textit{Perspectives on Terrorism} 6, no.6 (2012): 61-70.}

The weapons selection process corresponds with the psychological impact criteria described in the previous chapter, as terrorist attacks employing conventional tactics and weapons often inflict demonstrable psychological damage to victims and witnesses.\footnote{Phillip Anderson, \textit{Threat-Vulnerability Integration: A Methodology for Risk Assessment} (Washington, DC: Center for Strategic and International Studies, (2002): 4.} The impact of the population knowing that complex weapons of mass destruction are not required to cause a high volume of casualties and damage to critical infrastructure, but can occur at any time with more readily available weapons, creates a persistent fear amongst the populist and works to destabilize society.\footnote{Gennady Onishchenko, "Bioterrorism as Threat to Biological Security: Assessment of Healthcare Institutions Preparedness to Counteract Bioterrorism." In \textit{Bioterrorism as Threat to Biological Security: Assessment of Healthcare Institutions Preparedness to Counteract Bioterrorism}, by Vestnik and Akdemii Meditsinskikh Nauk Rossiyskoy, (Moscow: 2003): 9.}

\section*{Acquisition of Weapons}

Having established that firearms and bombings are the preferred methods of attack, terrorists must then shift their focus towards acquiring said weaponry. The procurement process ranges in complexity and duration based upon numerous variables such as financial resources, laws, location, criminal history, and relationships with potential suppliers. Lone actors may find the process inherently more difficult as there is less opportunity to collaborate and learn from individuals or groups who possess the requisite expertise, materials, and distribution channels. Despite these obstacles, lone wolf terrorists have proven successful in both acquiring weaponry and executing attacks. For example, anti-government extremist Luke Helder is responsible for...
conducting six bombings over a five-month period in 2002.\textsuperscript{242} This section will examine the weapons acquisition process and associated difficulties.

Regulations pertaining to the sale of explosive materials and precursor materials vary greatly depending on the nation. In the U.S., federal law regulates the sale of explosive grade materials such as ammonium nitrate, which is a commonly used explosive in IEDs. When mixed with fuel oil, it creates ANFO, a commonly used explosive material in IEDs and is prevalent in the commercial blasting industry, accounting for 95 percent of all commercial blasting in the United States.\textsuperscript{243} Since common uses of ANFO include mining, blasting, and road construction,\textsuperscript{244} terrorists may potentially establish a proxy construction company in order to purchase explosive materials via commercial channels. Other explosive materials are obtainable via the black market. During the 1970s and 1980s, thousands of tons of Semtex, a highly explosive energetic material, were transported out of Eastern Europe. Small-scale theft continued into the 2000s.\textsuperscript{245} In 2002, reports stated that Semtex was available for purchase on the black market for approximately $1,300 per kg.\textsuperscript{246}

Once terrorists have acquired the explosive materials, they must engage in the process of creating functional bombs. Despite an abundance of documents and schematics aiding in the


development process, the construction of IEDs has proven perilous. For context, from 1969-1996, the IRA lost around 120 members due to accidental or premature explosions of conventional bombs. By creating a research and development department comprised of internal and external experts, in which newer bomb makers and deployment teams learned kinesthetically from their predecessors, the IRA experienced a reduction in the number of accidental deaths, coinciding with Hoffman’s assessment that “every new terrorist generation learns from its predecessor.” Terrorists wishing to undertake an attack on the aviation sector using explosives will likely have to undergo a similar development process. This may be inherently more difficult for lone actors as, unlike their organizational counterparts, they often lack the ability to learn from more experienced terrorists.

Firearms are typically much easier to acquire, both via legal and illegal means. In some nations, such as the U.S., individuals can legally purchase firearms with minimal restrictions including background checks and basic weapons safety testing. Even regions with more restrictive firearms legislation, such as Europe, have seen an increase in the use of such weaponry in jihadist inspired terrorist attacks. From the period of 2001-2007, terrorists used knives and firearms in 7.3 percent of plots; after 2008, terrorists used the same weaponry in 33 percent of plots. Terrorists can also acquire firearms via illegal channels, such as the black market. As much as $1 billion worth of firearms enters the black market annually. A survey of

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248 Benjamin Friedman, Terrorizing Ourselves Why US Counterterrorism Policy is Failing and How to Fix it (Washington DC: CATO Institute, 2010), 146.
250 Brian Jackson, Aptitude for Destruction, Volume 2 (Santa Monica: RAND Corporation, 2005), 97-103.
U.S. arrestees revealed that more than half the arrestees (55 percent) said that guns are easy to obtain illegally.²⁵⁴

Acquired via legal or illegal methods, it is plausible to believe that terrorists seeking to conduct an attack on the aviation sector can readily obtain firearms and explosives. Airport security must anticipate that the majority of future attacks will be comprised primarily of explosives, firearms, and the intermittent use of vehicular ramming. Therefore, security officials should design deterrents and mitigation protocols around these attack modalities.

**Deterrents and Mitigation Recommendations**

Having established the most common types of weaponry used in terrorist attacks and the processes in which lone wolf terrorists acquire said weaponry, security personnel and government officials must focus on deterring, mitigating and preventing attacks against the airports and related infrastructure. This section will analyze the following: (1) physical security measures, (2) preemptive investigatory processes, and (3) preventive de-radicalization programs.

**Physical Security Measures**

In the U.S., the federal government mandates that commercial airports create secured or sterile areas in which employees and the public are subject to screening for weapons and other contraband. Per Title 49 CFR §1542.17, individuals and employees must be screened or have the appropriate access control identification criteria to gain access to these areas.²⁵⁵ In order to comply with this regulation, the TSA has implemented a comprehensive program consisting of

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²⁵⁵ Title 49 CFR §1542.17
21 layers of security including no-fly lists, passenger prescreening, behavioral detection officers, checkpoint/transportation security officers (TSOs), hardened cockpit doors, and random employee screening designed to work in conjunction with existing security agencies such as Federal Air Marshals and Customs and Border Patrol.\textsuperscript{256}

These security enhancements have directly reduced the frequency of certain types of terrorist plots, including aircraft hijackings leading to hostage scenarios. Prior to 9/11 and the implementation of enhanced security measures, the mean of aircraft hijackings leading to hostage scenarios was almost eleven incidents per quarter; since the implementation of enhanced security measures, such incidents have been reduced to slightly more than three per quarter.\textsuperscript{257} A more stringent security environment in the aviation sector has forced terrorists to rely on bombings more frequently and engage in a very low proportion of complex hostage-taking missions.\textsuperscript{258} Taking this paradigm shift into consideration, deterrents and mitigation recommendations will focus on public areas of airports, where the preponderance of recent attacks have occurred.

Terrorists will often conduct an informal vulnerability assessment to identify weaknesses in both the physical structure and security measures implemented at a target location to determine the type of attack, type of weapon, and tactics to employ to defeat identified defenses.\textsuperscript{259} One of the primary missions of airport law enforcement is to protect people and property from terrorist attacks. They accomplished this goal by providing multiple layers of

\begin{footnotes}
\item[258] Ibid, 260.
\end{footnotes}
detection and comprehensive training to mitigate potential casualties and physical damage. A strong police presence provides effective deterrents that influences terrorists’ behavior as they are inclined to conduct attacks on more vulnerable targets if the protective measures around primary targets are formidable.²⁶⁰

A frequently utilized method of crime deterrents implemented by law enforcement are high visibility patrols. A control group found that police protection induces a decline in auto theft of approximately 75 percent when concentrated in specific high occurrence areas.²⁶¹ However, such studies indicate that in order for high visibility deterrents to be effective, a visible police presence is required at numerous locations continuously.²⁶² The indefinite use of this tactic can place significant stress on resources and inflict physical strain on police personnel, drawing into question the long-term viability of such a strategy.

Physical barriers have proven effective in mitigating numerous attack modalities. In the 2007 Glasgow Airport attack, concrete bollards located around the central terminal area stopped a vehicular ramming assault by terrorists.²⁶³ The attack in Glasgow prompted a government review of the protection of strategic infrastructure, which recommended the installation of robust physical barriers as protection against vehicle bomb attacks and the creation of vehicle exclusion zones to keep all unauthorized vehicles at a safe distance.²⁶⁴

²⁶² Ibid.
²⁶⁴ Ibid.
Modifications to the physical design of airport terminals and public areas and the types of materials used to construct the structures have the potential to deter or minimize the effects of detonations or shootings. Blast proof materials reduce debris and minimize the potential for injury.265 Similarly, bullet resistant windows and panels provide fixed location security for individuals located behind such barriers. The use of such physical barriers around airports will provide enhanced security against various methods of attack. Airport designers can integrate such materials in new or existing structures without incurring onerous construction costs or dramatically altering the physical appearance of public areas.266

Investigative Processes

Law enforcement officials conduct numerous forms of investigations. Some investigations are designed to gather evidence to establish probable cause for an arrest, while others are preemptive in nature and are designed to detect suspicious or potential criminal activity before such activities occur. This section will examine preemptive methods of investigation, as law enforcement’s primary objective is to prevent criminal activity from occurring. Having established that the two primary methods of attack for terrorists are firearms and explosives, establishing effective detection methods for both types of attack modalities are essential.

Law enforcement officials conduct explosive detection investigations using a combination of machine detection devices and animal detection. During testing, K-9s have

displayed a detection rate of 91.46 percent,\textsuperscript{267} identifying various chemicals commonly used in explosives such as TNT, C4, commercial dynamite, and Semtex.\textsuperscript{268} The successful implementation of K-9 teams does not preclude the use of explosives by terrorists, but it may create a narrow window in which such devices may be used until they are detected and neutralized. The use of explosive detection K-9s also provides a high visibility deterrence benefit in addition to their primary mission.

The construction of explosive devices often leaves microscopic particles on the terrorist’s body and clothing and are invisible to the human eye.\textsuperscript{269} In order to detect such particles, security officials deploy explosive trace detection devices at screening checkpoints.\textsuperscript{270} Other devices, such as ion mobility spectroscopy, use vapor samples to detect common explosive chemicals such as RDX (used in C-4) and PETN (used in Pentolite).\textsuperscript{271} While such machines enhance the explosives detection capability near common target areas and help prevent individuals from entering the sterile areas (areas behind security screening) of airports with explosive materials, they also have limitations. For example, environmental conditions and the small vapor pressures of explosives often make detection of many samples difficult or inconclusive.\textsuperscript{272}

\textsuperscript{259} Irit Gazit, \textit{Explosive detection by sniffer dogs following strenous physical activity}, (Tel Aviv: Elsevier, 2001), 154.
\textsuperscript{271} Michael Krausa, \textit{Vapour and Trace Detection of Explosives for Anti-Terrorism Purposes} (New York: Springer-Verlag, 2005).
Firearm detection primarily occurs at screening locations. Advanced Imaging Technology (AIT) systems generate images that can reveal anomalies underneath passenger clothing, allowing detection of concealed items, such as explosives, detonators, and both metallic and nonmetallic weapons such as firearms. AIT’s consist of X-ray backscatter systems, which use a low-intensity X-ray beam that moves at high speed to scan the entire surface of the body, or millimeter wave imaging systems, which emit non-ionizing electromagnetic radio waves in the millimeter wave (30-300 gigahertz) spectrum to render images of what lies directly underneath clothing and near the skin.273

While such machinery provides a means of detection, performance estimates found that certain items, such as certain types of explosives used in past terrorism incidents targeting aircraft, could be difficult, if not impossible, to detect using X-ray backscatter systems at permissible radiation exposure levels.274 Additionally the DHS Office of Inspector General has raised concerns over the adequacy of TSA’s on-the-job training to operate AIT units and inconsistencies in the use of calibration procedures to ensure appropriate image quality.275

Other detection methods, such as metal detectors or CTX machines, which identify threats in checked baggage, have similar deficiencies, namely the possibility of inadequate training of operators or understaffing of operators. The TSA and EU airport security personnel operate such machines at fixed locations that require terrorists to knowingly enter the screening


area and submit to the screening process, actions with which terrorists seeking to engage in an active shooter attack are unlikely to comply.

Enhancing automated detection methods presents opportunities to identify suspicious activity and allow law enforcement officers to interdict terrorists prior to execution of the attack. CCTV systems integrated with artificial intelligence programs, such as facial recognition technology, can be installed in public and sterile areas of airports and related infrastructure and allow law enforcement officials to crosscheck suspects against existing terrorist watch lists.276 Similarly, automated license plate readers can be used to generate alerts and collateral information about vehicles of interest.277

Law enforcement and security personnel receive comprehensive training to detect suspicious behavior. In the US, the TSA behavior recognition program trains officers to identify individuals that exhibit suspicious actions and may request law enforcement officers to investigate when needed.278 The Belgium Federal Police provide officers with behavior awareness training and station them at airport entrances to assess possible threats from individuals entering public areas. If officers detect unusual activity, they may pull aside suspicious individuals for additional screening.279

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277 Keith Gierlack and Shara Williams, License Plate Readers for Law Enforcement: Opportunities and Obstacles (Santa Monica: RAND Corporation, 2014)
Engaging the public and encouraging them to report suspicious behavior via the promotion of “see something, say something campaigns” often generates an increase in tips and leads.\textsuperscript{280} Local law enforcement, ideally, terrorism liaison officers who receive additional training related to terrorist behavior, receive these leads and often conduct investigations based upon the information acquired by the reporting public. If warranted, police officers submit suspicious activity reports to the Federal Bureau of Investigation (FBI) for further investigation of suspects.\textsuperscript{281}

The use of explosive detection K-9 teams and sophisticated trace detection and millimeter wave imaging systems create a formidable combination of resources designed to detect explosives and firearms. However, such technologies have inherent limitations, including a lack of mobility and range. More proactive technologies, such as CCTV systems utilizing artificial intelligence, in conjunction with traditional human behavioral observation officers trained to investigate suspects, provide active detection and investigation options. While early detection of terrorist plots does not assure prevention, early detection does provide law enforcement officers with valuable information, and such information enables officers to conduct comprehensive investigations.

\textit{Counter Violent Extremism (CVE) Programs and Initiatives}

While numerous nations operate forms of counter-radicalization programs, this essay will examine the programs operated by the U.S. and U.K. as they are both democratic nations that

\begin{footnotesize}
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\item Brian Michael Jenkins and Bruce R. Butterworth. \textit{Does “See Something, Say Something” Work?} (San Jose: Mineta Transportation Institute, National Transportation Center, 2018).
\end{itemize}
\end{footnotesize}
have experienced a proliferation of lone wolf terrorist attacks. The primary functions of both the U.S.’s and U.K.’s counter-radicalization programs are to proactively confront and mitigate root causes, frames, the proliferation of radical ideology and social networks that lead to violent radicalization. A critical component of the U.K.’s Contest strategy, known as Prevent, employs a multi-faceted approach that uses community outreach organizations that specialize on different segments of the Muslim community.\(^{282}\) For cases of early detection, officials deliver interventions through local partners and specialist agencies via the Channel Programme. The support may focus on a person’s vulnerabilities around health, education, employment or housing, as well as specialist mentoring or faith guidance and broader diversionary activities. Officials customize support packages to the person and their particular circumstances.\(^{283}\)

Other specialized programs focus on more specific root causes, such as The Waltham Forest Young Muslim Leaders Development (WFYMLD) program, which concentrates on training Muslim youth who face isolation, drug and alcohol abuse, and economic hardship.\(^{284}\) Perhaps none of these programs are more prominent then the British Muslim Forum (BMF), an independent, national representative body of Mosques, Muslim institutions and community organizations in the UK that has received over £435,000 from the government.\(^{285}\) The BMF coordinates with affiliated Mosques to improve governance standards and, in 2005, famously issued a fatwa condemning terrorism and suicide bombings following the July 7, 2005 London


\(^{283}\) Home Office. Channel guidance Protecting vulnerable people from being drawn into terrorism. (London: Crown Copyright, 2012)


attacks. Over 500 Imams and Muslim clerics from the UK signed the decree. Because the BMF operates within local communities’ religious/social milieus, the BMF serves as a conduit to deliver a message of moderation rooted in Islamic principles, which serves to counter the onslaught of radical violent propaganda individuals may receive online or through radical social networks.

Published in 2011, the Preventing Violent Radicalization in America strategy focuses on the collection and dissemination of current best practices in counter-radicalization methodologies to facilitate training regimes for federal, state and local law-enforcement and relevant members of the community, which in turn has led to significant reductions in violent crime. This has manifested in a limited number of extremely well-financed programs such as The Office of Community Oriented Policing Services (COPS Office), which is the component of the U.S. Department of Justice responsible for advancing the practice of community policing through information and grant resources. Since 1994, the COPS Office has invested more than $14 billion to help advance community policing. It operates under the premise that leveraging thousands of well-established relationships between community members and law-enforcement officers will improve counter-radicalization efforts. Bjelopera reiterates this notion by stating, “Evidence of a potential terrorist threat or organized criminal enterprise is far more likely to be found in the incidental contact with the 10,000 police officers in the state of Washington than by the less than 150 FBI agents assigned to the Seattle Field Division.”

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288 United States Department of Justice. N.d. “About The Office of Community Oriented Policing Services.”
policing efforts, the U.S. Congress made information sharing a priority of the new DHS intelligence organization. DHS is required it to disseminate, as appropriate, information analyzed by the Department to other agencies of the federal government with responsibilities related to homeland security, and to agencies of state and local government and private sector entities, in order to assist in the deterrence, prevention, preemption of, or response to, terrorist attacks against the United States. Other law enforcement led, counter-radicalization programs such as the DHS and DOJ-led CVE Task Force and local fusion centers have displayed varying degrees of effectiveness.

CVE programs are far from universal successes. Preventing violent extremism programs in both the U.K. and U.S. have focused almost exclusively on the Muslim community, an approach that the ACLU has criticized as reinforcing the negative stereotype that Islam is synonymous with terrorism and has been “damagingly counterproductive.” A lack of a cohesive CVE strategy has plagued counter-radicalization efforts. Although the basic guidelines exist, “opaque and jargon-filled language” makes clear objectives difficult to accomplish. The U.K government frequently allocates funds to community organizations with minimal research conducted into their backgrounds or political proclivities.

In the United States, a combination of constitutional restrictions, primarily the Establishment Clause, which prohibits the establishment of religion by congress, prevents direct funding to religious community outreach organizations, as is common practice in the U.K. This requires the distribution of funds to counter-radicalization funds to go through federal, state and

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290 Ibid, 47.
292 Ibid, 5.
local government entities. Furthermore, constitutional democracies need to be cognizant not to inadvertently violate citizens’ rights via common investigative methods such as consensual encounters that may potentially escalate to illegal detentions or search and seizure violations.  

Both the U.S. and U.K. have instituted well-funded counter-radicalization programs. Each country, due to inherent limitations and demographic requirements, have taken divergent courses, with some aspects of their programs mirroring common best practices, such as community policing models. The realities of each nation’s geo-political climates restrict the types of schemes they can implement. Ultimately, an amalgamation of components from the U.S.’s and U.K.’s programs would create a more effective and comprehensive counter-radicalization strategy for both nations, and it may serve as a model for other democratic nations.

Conclusion

Terrorists will select any given target and the corresponding attack modality based upon two variables: “capability and motive.” In respect to capability, lone wolf terrorists operate with considerably less training and resources than their organizational counterparts. This means that their attack modalities must be more simplistic. This is consistent with data indicating that lone wolf terrorists elect to use firearms in the majority of attacks followed by explosives. In respect to motive, terrorists evaluate the totality of a target’s characteristics during the decision-making and target selection process. These characteristics include a target’s level of protection, profile status, utility, potential to cause economic disruption, and the potential for a mas-

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294 Michael Lipka, “Muslims and Islam: Key findings in the U.S. and around the world.” Pew Research Center, August 9, 2017, 3-4
casualty event. In addition, terrorists must determine that the selected target is susceptible to their preferred attack modality. Based upon the criteria established and the weaponry available, the aviation sector represents a highly desirable target for lone wolf terrorists. As a result, security officials must take all possible actions to create a secure environment to deter, mitigate, or prevent such attacks.

Designers can incorporate certain physical security measures into the design of airports, cargo facilities, and other aviation sector infrastructure to mitigate the effects of the most commonly used terrorist weaponry, including explosives and firearms. However, it is impractical to expect that physical security measures alone are capable of defeating such attacks. Governments must consider implementing more restrictive gun control and explosive material policies with the intent of impeding terrorists’ from acquiring precursor materials, energetic materials, firearms, and ammunition. Ultimately, physical security and detection measures provide an additional layer of protection that has the potential to save lives; however, it is impractical to believe that terrorists will cease to innovate and seek alternate methods of attacking the aviation sector no matter how tough the overall security environment becomes.

Numerous democratic nations, including the U.S. and U.K., have implemented forms of counter violent extremism programs and have experienced varying degrees of success. Although CVE programs in the U.S. and U.K have adequate funding, wasteful spending and distributions to controversial sources have caused watchdog organizations to question the administration of funds. CVE programs have disproportionally concentrated on members of the Muslim

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296 Ibid, 44.
community, creating allegations of racial profiling, and may have the inadvertent effect of alienating portions of the population that they are attempting to engage. Constitutional limitations have the effect of protecting individual liberties, but also serve to restrict the effectiveness of certain CVE programs.

Upon examining the preponderance of data elucidated in this chapter, it appears probable that airports will continue to remain a highly desirable terrorist target for the near future. Security officials must incorporate advanced physical security and detection measures to deter and mitigate terrorist attacks. Governments must also consider enhancing counter violent extremism programs in order to reduce the potential terrorist population and decrease the number of lone wolf attackers seeking to target the aviation sector. While such enhancements do not reduce the appeal of airports as potential targets, they may serve to deter future attacks, as terrorists may perceive the target as well defended, effectively diminishing the likelihood of success.

**Thesis Conclusion**

The emergence of domestic terrorism has fundamentally changed society. In the not too distant past, individuals were able to walk into a sports stadium or airport boarding gates unimpeded. Now, metal detectors and security personnel greet patrons when they enter such facilities. While it is unlikely that the security environment will revert to the carefree days of the past, by developing a sophisticated understanding of terrorists’ motivations, attack modalities, and targeting preferences, it may be possible to mitigate the threat that terrorists pose. This thesis examines two primary concepts: (1) the effective degradation of terrorist organizations by the U.S. and allied nations has contributed to the proliferation of lone wolf terrorism, and (2) that the greatest vulnerability to lone wolf terrorism is critical infrastructure, with the aviation sector
being the most desirable target. This conclusion will elaborate on these concepts and analyze recommendations to enhance aviation sector security.

**Summary of Chapter I**

Much of the global counterterrorism efforts have focused on organizational terrorists. This is primarily due to the imminent threat that terrorist organizations pose. In 2017, the Islamic State of Iraq and the Levant was responsible for executing 1,321 attacks. In contrast, 88 individuals carried out a total of 198 lone wolf attacks between 1968 and 2010. As a result the U.S. and its allies have systematically targeted the two most prominent terrorist organizations in the world through a combination of military actions, intelligence operations, and various financial instruments. Al-Qaeda and ISIS have both experienced significant losses in terms of manpower, financial resources and the amount of physical territory held under their control. Consequently, their ability to plan and execute major terrorist operations has been diminished. Cognizant of their circumstances, terrorist organizations have shifted their focus from planning and executing major offensive operations to actively encouraging potential sympathizers worldwide to join the jihad and launch low-tech attacks in areas not encompassed within their area of operation. As a result of Islamic State propaganda activities, both the United States and Europe experienced approximately twice as many successful lone wolf attacks in 2015 and 2016 as they did in the 2011-2014 period. Not only are lone wolf attacks becoming more prolific,

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they are also becoming more deadly. A 2003 study by Professor Christopher Hewitt, of the University of Maryland, revealed that between 1955 and 1999 lone wolf terrorists accounted for just two percent of all terrorist arrests but resulted in 15 percent of terrorist fatalities.\textsuperscript{300}

The proliferation of terrorist attacks is not restricted to radical Islamic terrorism. Spaaij found that between 1968 and 2007 lone wolf terrorism only accounted for 1.28 percent of all terrorist incidents worldwide, but in the U.S. it accounted for 42 percent of all cases, with white supremacist, Islamist, and nationalist/separatist motivations topping the ideological sources for lone wolf attacks.\textsuperscript{301} These findings indicate that domestic and lone wolf actors pose a substantial risk to the safety and security of nation-states and their citizenry.

Common characteristics were identified based upon available empirical data in an effort to better understand which individuals are most likely to radicalize. The age range of lone wolf terrorists committing their first terrorist offense in the U.S. and Europe was 15-69 years old with an average age of 33 years old.\textsuperscript{302} In respect to gender, 96.6 percent of lone wolf terrorists are male, with females accounting for just 3.4 percent of the lone wolf terrorist population.\textsuperscript{303} The incarceration rate for lone wolf terrorists is high relative to the general population and members of terrorist organizations; 41.2 percent of lone-actor cases had previous criminal convictions prior to committing acts of lone wolf terrorism.\textsuperscript{304} In the U.S., 40.2 percent of lone wolf terrorists were unemployed and 9.8 percent were students. The other half of the sample were employed but

\textsuperscript{300} Christopher Hewitt, \textit{Understanding Terrorism in America: From the Klan to Al- Qaeda} (New York: Routledge, 2003).


\textsuperscript{303} Ibid.

\textsuperscript{304} Ibid.
at lower quality jobs; for example, 23.2 percent were employed in the service industry and just 10.7 percent were employed in professional occupations.\textsuperscript{305} In total, 24.7 percent of lone wolf terrorists either attended or completed high school or secondary education, 32.5 percent either attended a community college, trade school, or university undergraduate education but did not graduate; 22.1 percent completed some form of community college, trade school, or university education and graduated. Of the 20.8 percent of lone wolf terrorists that participated in graduate school, 6.5 percent graduated with a master’s degree, 7.8 percent graduated with a doctoral degree and the remaining percentage failed to graduate.\textsuperscript{306}

Approximately 50 percent of lone wolf terrorists were single and had never married, 24.4 percent were married, and 18.9 percent were divorced or separated.\textsuperscript{307} The rate of mental illness is high amongst lone wolf terrorists; 40 percent of lone wolf terrorists experienced some form mental illness. This constitutes a rate of occurrence that is significantly higher than the 7.6 percent mental illness rate documented amongst organizational terrorists.\textsuperscript{308} Of the Al-Qaeda inspired lone wolf terrorists, 37.3 percent were religious converts.\textsuperscript{309} This signifies a higher conversion rate than is typically experienced amongst organizational terrorists. Twenty-nine percent of those individuals involved in ISIS-related terrorist plots were religious converts.\textsuperscript{310}

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\textsuperscript{305} Ibid. \\
\textsuperscript{306} Ibid. \\
\textsuperscript{307} Ibid. \\
\textsuperscript{308} Jeff Gruenewald, Steven Chermak and Joshua D Freilich, "Distinguishing “Loner” Attacks from Other Domestic Extremist Violence: A Comparison of Far-Right Homicide Incident and Offender Characteristics." \textit{Criminology and Public Policy} 12 (2013): 65-91. \\
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In summary, Chapter I establishes that the degradation of prominent terrorist organizations has led to the proliferation of lone wolf terrorism. While there is no known method of positively identifying potential lone wolf terrorists, a set of common characteristics may help security officials create general parameters to investigate suspicious or vulnerable individuals. This information will help to establish the rationality of lone wolf terrorists and the criteria they utilize when selecting targets, which is the focus of the next chapter.

Summary of Chapter II

This chapter establishes the criteria that lone wolf terrorists utilize to select targets and is comprised of three sections. The first section attempts to determine if lone wolf terrorists act in a rational or irrational manner when evaluating potential targets. The results are significant because establishing rationality helps to determine if terrorist attacks are simply random events that are impossible to predict, or if lone wolf terrorists use reasoning and follow a logical selection process that can help security officials predict likely targets. While there are contrasting opinions, the preponderance of data indicates that lone wolf terrorists are generally rational. Analysis from previous lone wolf attacks found strong indicators that in the majority of instances, evidence of premeditation was present, including high degrees of in-person training, virtual training, and the physical possession of training materials.\(^\text{311}\)

In his work “Modus Operandi in Understanding Lone Wolf Terrorism,” Spaaij supports the idea that the lone wolf target selection process is logical through a series of case studies which reveal that lone wolf terrorists typically attack symbolic targets.\(^\text{312}\) This proclivity

\(^{311}\) Paul Gill, "Seven Findings on Lone-Actor Terrorists," *International Center for the Study of Terrorism*, (February 6, 2013): https://sites.psu.edu/icst/2013/02/06/seven-findings-on-lone-actor-terrorists/.

becomes even more apparent when lone wolf terrorists conduct multiple attacks, as they often select a range of targets that possess symbolic value and belong to identified enemies or contain individuals deemed to be adversaries. Additionally, lone wolf terrorists inspire copycat behavior and serve as motivational role models for other alienated youth, who occasionally emulate this behavioral pattern. By studying the methodology of previous terrorists, lone wolf terrorists tend to display signs of premeditation prior to attacks; combined with other indicators, it appears that lone wolf terrorists utilize a logical target assessment process.\(^{313}\)

The results and discussion portion of this chapter introduce seven primary criteria used to determine the appeal of potential targets and how they correspond to the aviation sector. These criteria are based off of Ackerman’s influential work “Assessing Terrorist Motivations for Attacking Critical Infrastructure.” The criteria include: (1) casualties, (2) target value, (3) symbolic value, (4) economic impact, (5) psychological impact, (6) influence of similar attacks, and (7) interconnectedness.\(^{314}\) In the third portion of this chapter, an analysis of various critical infrastructure sectors reveals that while other critical infrastructure sectors fulfill many of the established criteria, the aviation sector most closely aligns with all seven criteria and is likely to become the most desirable critical infrastructure target for lone wolf terrorists.

**Summary of Chapter III**

The first portion of chapter III establishes the most common attack modalities used by terrorists and seeks to determine if the aviation sector is susceptible to such weaponry. The results indicate that due to limited resources and training, lone wolf terrorists rely on more


simplistic attack modalities than their organizational counterparts. In Europe, firearm attacks accounted for 37 percent of all attacks, followed by explosives, accounting for 20 percent of all attacks.\textsuperscript{315} A study of numerous Western democratic nations found that lone wolf terrorists used firearms in 43 percent of attacks and explosives in 28 percent of attacks; armed hijackings accounted for 16 percent of all attacks and six percent of attackers committed arson.\textsuperscript{316} While regulations reduce the availability of such weaponry, particularly energetic materials used in the construction of explosive devices, legal and illegal conduits enable terrorists to acquire weaponry, with firearms being particularly easy to obtain in the United States.

Having established the most likely attack modalities that lone wolf terrorists will use against the aviation sector, this chapter then explores potential mitigation and prevention techniques. These recommendations include: (1) physical security measures, including the installation of physical security barriers and blast resistant materials; (2) preemptive investigatory processes; including CCTV systems equipped with facial recognition and artificial intelligence systems, high visibility police patrols, explosive detection K-9 teams, and explosive detection machinery. While all the above-mentioned systems have inherent limitations, when used in conjunction, they may provide effective deterrents and may aide in the early detection of potential attacks.

The third portion of this chapter explores government policies and programs designed to prevent the radicalization of potential terrorists, or de-radicalize existing terrorists, and


\textsuperscript{316} Petter Nesser, "Research Note: Single Actor Terrorism: Scope, Characteristics and Explanations," \textit{Perspectives on Terrorism} 6, no.6 (2012): 61-70.
determines if such programs have the potential to reduce the terrorist population. Due to constitutional restrictions, governments design such programs to be non-intrusive and have consequently yielded limited results. The results from this section are generally inconclusive and identify the need for further research. However, policy recommendations for stricter gun control laws in the U.S. and additional funding in all nations that utilize de-radicalization programs is required.

Conclusions

Terrorism is an enduring threat. The process of identifying and dismantling terrorist organizations is an extraordinarily costly process. The U.S. wars in Afghanistan, Iraq, Syria, and Pakistan have cost $5.9 trillion since they began in 2001. More than 480,000 people have died, and more than 244,000 civilians have been killed from the wars. As a result, ISIS has lost virtually all of its territory and much of its personnel, and Al Qaeda has lost the majority of its leadership, which is responsible for planning operations. However, ISIS, Al Qaeda, and the Taliban all continue to persist and their very existence motivates sympathizers to join their cause.

The proliferation of lone wolf terrorists creates a more formidable challenge for security officials as lone wolf terrorists are inherently more difficult to identify and investigate than their organizational counterparts. Lone wolf terrorists communicate less (which provides less opportunity for the intelligence community to gather signal intelligence), require less funding

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318 Ibid.
and occupy no physical territory. Additionally, citizens, even domestic terror suspects, are entitled to constitutional protections that limit the investigatory process.

Individuals radicalize due to a combination of root causes. The events that lead to feelings of isolation and exclusion from society are impossible to prevent. For example, in the U.K., social isolation through the establishment of Muslim ghettos has created a sense of social exclusion amongst many Muslims. This sentiment is supported by polling that reveals one-third of Europeans admit to being quite or very racist. Furthermore, the government in the U.K. has sent conflicting narratives by funding non-violent Islamists whose ideological message contradicts the moderate narrative encouraging assimilation and participation within U.K. society.

As a result of the social-political climate, it seems unlikely that lone wolf terrorism will ever be eliminated. However, vulnerable individuals can be helped through a combination of radicalization prevention and de-radicalization programs. Such programs must be designed for the target population. For example, most radicalization prevention programs focus on the Muslim community. However, the Muslim community in the U.S. comprises less than one percent of the U.S. adult population compared to 5.4 percent in the U.K. The U.K. places 28th on the global terrorism index compared to the U.S. which places 35th. There are approximately three

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million Muslims in the United States, and a little more than 100 have joined jihad, about one out of every 30,000, suggesting an American Muslim population that remains hostile to jihadist ideology and its exhortations to violence. In contrast, approximately 850 people from the UK have travelled to support or fight for jihadist organizations in Syria and Iraq, indicating that the threat of Islamic radicalism is greater in the U.K.

How to Address the Problem

The following recommendations supplement and expand upon the recommendations proposed in chapter III.

1. Radicalization Prevention/De-radicalization programs:

   The easiest way to prevent terrorists from attacking the aviation sector is to prevent terrorists from radicalizing. For example, financial assistance programs can be implemented in virtually all nations. This has already proven successful in non-democratic nations like Saudi Arabia, where the government provides stipends for cars and apartments, funding for psychological counseling and social services after the release of inmates, and invests heavily into the social networks surrounding the de-radicalized individual. This incentivizes normalized behavior by providing families with schooling, health care, and financial assistance to offset the loss of income during incarceration.

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323 Brian Michael Jenkins, Would-Be Warriors Incidents of Jihadist Terrorist Radicalization in the United States Since September 11 (Santa Monica, CA: RAND Corporation, 2010).

Yet other components of the Saudi program are incompatible with liberal democracy, such as informing the “prisoner's wider familial network that they will be held partly responsible for his behavior after his release.”\textsuperscript{325} The notion of charging citizens with crimes for which there is no evidence to support their involvement is clearly antithetical to the right of due process. However, portions of the Saudi de-radicalization program have proven quite effective. Saudi Arabia claims a recidivism rate of just one to two percent.\textsuperscript{326} This is a direct result of sustained de-radicalization efforts.

In the United States, by 2023, at least 80 of the more than 275 inmates convicted for jihadism-related offenses since 9/11 will be released from custody. In addition, numerous extremists of other persuasions will be released.\textsuperscript{327} It may prove beneficial to introduce similar elements of the Saudi deradicalization program in the U.S. custody system in order help individuals reacclimate to society, find steady employment, and prevent instances of recidivism. However, constitutional limitations such as the Establishment Clause may prevent the implementation of certain components of foreign based de-radicalization programs in the U.S., in addition, cultural nuances need to be accounted for when considering the implementation of de-radicalization programs in both the U.S. and other democratic nations. Essentially, the realities of each nation’s geo-political climate restrict the types of schemes they can implement.

\textsuperscript{326} Ibid, 307-308.
2. **Introduce more stringent gun control legislation**

The recommendation to introduce stringent gun control legislation is more relevant to the United States, as many European nations have already enacted legislation that has dramatically reduced the availability of various types of firearms. Several factors make this recommendation difficult to enact. The second amendment of the U.S. Constitution ensures the right of the people to keep and bear arms. The federal and state governments have passed legislation to modify this constitutional right in an effort to conform to the realities of modern society and provide protections against criminal activity. For example, under federal law, people with felony convictions forfeit their right to bear arms. Although, in some instances, restoration of this right is automatic for nonviolent felons as soon as they complete their sentences. However, as addressed in Chapter I, many potential terrorists do not have a prior criminal history and can legally purchase firearms, which is the most common attack modality for lone wolf terrorists.

Politicians have advocated for numerous gun control proposals to reduce the access of firearms to potential criminals. The measures include universal background checks to cover private sales and gun-show transactions, red flag laws allowing the confiscation of guns from people judged to be a danger to themselves or others, a ban on large-capacity magazines, and a ban on assault weapons. Despite each proposal garnering majority support from the public, resistance from gun rights advocates has prevented the passage of comprehensive gun control

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legislation. Until the social milieu forces legislative action, this recommendation is unlikely to have a meaningful impact.

3. **Incorporate physical changes to airport design**

Although Chapter III reviews numerous security enhancements that airport designers can build into structures, including the use of blast resistant materials and the installation of physical barriers, additional safety features may be added to enhance the physical security of terminals and cargo facilities. Of all the recommendations proposed in this conclusion, this is the easiest to implement, as it does not require the passage of federal legislation nor does it threaten to violate individual freedoms.

Additional security measures can be segregated into two categories: (1) optical/auditory deception, and (2) crowd reduction. The concept behind optical illusion is to alter terrorists’ perceptions of the physical target and its vulnerabilities. Designers achieve optical illusion by altering environmental conditions and visual perceptions. For example, open areas can be brightly illuminated allowing the public to operate as usual, however subdued lighting in areas where crowds typically gather, such as ticket counters and screening areas, can reduce visibility and make it more difficult for attackers to locate targets. Similar results are achieved using physical devices, such as mirrors and camouflage design features that make crowds and structures appear larger or smaller than they actually are. The use of artificial ambient noise provides auditory deception and makes attackers believe that large groups of people occupy areas that are either sparsely occupied or are not occupied at all.

Crowd reduction technologies restrict the number of potential targets occupying public areas of airports. Passengers generally congregate around ticketing counters, baggage drop off
locations, and screening stations. Some crowd reduction solutions are easily implemented, such as encouraging the use of e-tickets, which allow individuals to bypass the ticketing counter and thereby reduce the overall number of people in the public area. Creating multiple bag drop locations allows for the dispersal of crowds and creates greater distance between attackers and passengers. Automated technologies allow passengers to weigh and pre-pay for checked luggage prior to arriving at the airport and can significantly decrease airline check-in lines. Finally, improving the efficiency of the screening process will reduce the number of people standing in line at any given time. Encouraging enrollment or subsidizing programs such as TSA precheck, which expedites screening for passengers who have previously submitted to a background check, may effectively reduce the number of potential targets in public areas of airports. Such measures will not only improve operational security, but may improve the customer experience and potentially help airlines and airports save on personnel costs.

Due to the inherent desirability of the aviation sector, terrorists will likely continue to perceive airports as priority targets. Although little can be done to reduce the sector’s symbolic value and other identified target selection criteria, improvements can be made to enhance the security in airports and related infrastructure. On a broader scale, government policies designed to prevent or de-radicalize terrorists have proven difficult to implement in many democratic nations. However, such programs may provide utility if the appropriate conditions emerge. Ultimately, security officials need to be cognizant of the threat posed by lone wolf terrorists and take the necessary steps to proactively create a viable deterrent by enhancing human security.

resources while simultaneously incorporating new technologies that better mitigate potential attacks.
Appendix

Definitions

Critical Infrastructure:

Systems and assets, physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health and safety, or any combination of those matters.\(^{330}\)

Lone wolf Terrorist:

Will refer to the threat or use of violence by a single perpetrator (or small cell), not acting out of personal material reasons, with the aim of influencing a wider audience, and who acts without any direct support in the planning, preparation and execution of the attack, and whose decision to act is not directed by any group or other individuals (although possibly inspired by others).\(^ {331}\)

Cyber Terrorism:

Is a criminal act perpetrated by the use of computers and telecommunications capabilities, resulting in violence, destruction and/or disruption of services to create fear by causing confusion and uncertainty within a given population, with the goal of influencing a government or population to conform to a particular political, social, or ideological agenda.\(^ {332}\)


Weapons of Mass Destruction:

Any explosive, incendiary, or poison gas, including the following: a bomb; grenade; rocket having an explosive or incendiary charge of more than four ounces; missile having an explosive or incendiary charge of more than one-quarter ounce; mine; or device similar to any of the previously described devices;

- Any weapons that is designed or intend to cause death or serious bodily injury through the release, dissemination, or impact of toxic or poisonous chemicals, or their precursors;
- Any weapon involving a disease organism; and
- Any weapon that releases radiation or radioactivity at a level dangerous to human life.\textsuperscript{333}

\textsuperscript{333} Title 18 U.S.C. §2332a


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Publications and Scholarly Work
Theses
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