

ASSESSING CHEMICAL WEAPON FACTORS: A CASE STUDY COMPARISON OF ISIS  
AND AUM SHINRIKYO

by  
Patrick Lucey

A research study submitted to Johns Hopkins University in conformity with the requirements for  
the degree of Master of Arts in Global Security Studies

Baltimore, Maryland  
August, 2021

© 2021 Patrick Lucey  
All Rights Reserved

## **Abstract**

This social science research study examines the chemical weapon attributes associated with violent non-state actors (VNSA). The focus is on the question: *What factors impact the development and use of chemical weapons by VNSAs?* The chemical weapon threat posed by VNSA groups is enduring and predicated on multiple factors, which can determine the effectiveness of such an initiative. By examining these factors and determining which are the most relevant, measures can be taken to counter the threat that chemical weapons pose. This paper attempts to address these concerns by executing a case study comparison of the chemical weapon activities associated with two VNSAs, Aum Shinrikyo and the Islamic State of Iraq and Syria (ISIS), in order to derive insights related to significant differences and similarities between the two organizations. Using the insights from the comparative analysis, recommendations are provided to best address the most critical factors associated with VNSA chemical weapon efforts. Ultimately, this study determined that an increase in available safe haven or an ability to change approaches to technology makes a VNSA chemical weapon effort more likely.

**Primary Reader and Advisor:** Dr. Sarah Clark

**Secondary Reader:** Dr. Kevin Woods

## **Acknowledgements**

I owe my sincerest gratitude to my friends, family, colleagues, and professors who motivated me to persevere and pursue knowledge and understanding in an increasingly dangerous world.

Additionally, I could not have done this without my friends Autumn and Levi, who made me a better writer and analyst.

## Table of Contents

<b>Abstract.....</b>	<b>ii</b>
<b>Acknowledgements.....</b>	<b>iii</b>
<b>List of Figures.....</b>	<b>v</b>
<b>Introduction.....</b>	<b>1</b>
<b>Literature Review.....</b>	<b>2</b>
<b>Hypothesis and Methods.....</b>	<b>11</b>
<b>Data Acquisition: ISIS and Aum Shinrikyo Timeline of VNSA Chemical Weapon Factors.....</b>	<b>15</b>
<b>Data Acquisition: Safe Haven.....</b>	<b>17</b>
<b>Data Acquisition: Technical Experts.....</b>	<b>19</b>
<b>Data Acquisition: Funding.....</b>	<b>21</b>
<b>Data Acquisition: Production Facilities.....</b>	<b>23</b>
<b>Data Acquisition: Leadership Endorsement.....</b>	<b>25</b>
<b>Data Acquisition: An Ability to Change Approaches to Technology.....</b>	<b>27</b>
<b>Discussion.....</b>	<b>30</b>
<b>Comparative Analysis and Findings.....</b>	<b>42</b>
<b>Limitations and Future Research.....</b>	<b>47</b>
<b>Conclusion.....</b>	<b>48</b>
<b>Bibliography.....</b>	<b>51</b>
<b>Curriculum Vitae.....</b>	<b>56</b>

## List of Figures

Figure 1: Technical Complexity and Success Rate.....	8
Figure 2: Practical Constraint Theory and Strategic Constraint Theory Considerations.....	10
Figure 3: ISIS Revenue 2014-2016.....	22
Figure 4: Satyan 7 Sarin Production Facility.....	24
Figure 5: Practical Constraint Model and ISIS/Aum Shinrikyo Agent Pursuits.....	31
Figure 6: ISIS Chemical Weapon Attacks in Iraq and Syria.....	36
Figure 7: Chemical Structure of Nerve Agents.....	44
Figure 8: Chemical Structure of Blister Agents.....	44

## Introduction

In 1988, the speaker of Iran's parliament, Hashemi Rafsanjani referred to chemical and biological weapons as the "poor man's atomic bomb."<sup>1</sup> This characterization is identifiable with the sentiment that an actor with limited resources could devise a means to achieve a weapon state that could be leveraged as a deterrent or to inflict mass casualties. As such, a VNSA that possessed several preliminary factors could theoretically achieve a chemical weapon if the VNSA had the proper resources, personnel, technology, and strategy. Paul Cornish summarized this concept as followed:

"Although the large-scale production, weaponization and delivery of chemical weapons would be challenging, scientifically and logistically, as well as extremely expensive, a small number of low-yield chemical weapons would be relatively easy to hide and transport and might thus appeal to a well-organized and well-funded terrorist group."<sup>2</sup>

VNSAs continue to adapt to counterterrorism pressure and are emboldened to implement strategies advantageous to their organizational integrity and survival. Although not every VNSA will be able to add chemical weapons to their arsenal, the concern remains that the most dangerous amongst these actors could have that ability.

The purpose of this paper is to investigate the factors integral to a VNSA chemical weapon effort and determine which are the most significant. This paper first considers the broader literature and then transitions to discuss the hypothesis and research methods involved. Within these sections of the paper, the factors impacting the development and use of chemical weapons by VNSAs will be identified. When considering the "effectiveness" or "impact" of VNSA chemical weapon

---

<sup>1</sup> "North Atlantic Assembly AN 255 STC(96) 10 - CHEMICAL AND BIOLOGICAL WEAPONS: THE POOR MAN'S BOMB." Federation of American Scientists. Last modified October 4, 1996. <https://fas.org/irp/threat/an253stc.htm>.

<sup>2</sup> Cornish, Paul. "The CBRN System: Assessing the Threat of Terrorist Use of Chemical, Biological, Radiological and Nuclear Weapons in the United Kingdom." Chatham House, February 2007, 1-40. <https://ciaotest.cc.columbia.edu/wps/riia/0001540/0001540.pdf>.

factors this will be defined either as a VNSA producing and using a relatively complex chemical agent or chemical weapon effort modifications that are conducive for the group's operational success. VNSA chemical agent effort modifications may involve a shift from complex agent pursuits to more simplistic efforts. After the literature review and methods section, data will be collected and analyzed in accordance with a case study comparison of Aum Shinrikyo and ISIS. This paper will then conclude with recommendations as to how readership should deal with the VNSA chemical weapon threat.

## **Literature Review**

When attempting to characterize the factors impacting the development and use of chemical weapons by VNSAs, it is important to understand the drivers associated with these unconventional pursuits. Jonathan Tucker stipulated that terrorist organizations tend to be conservative in their attack protocols, relying on well-established tactics, techniques, and procedures (TTPs) and innovating only when necessary.<sup>3</sup> What's more, some scholars have stipulated that VNSA groups are dissuaded from pursuing weapons of mass destruction (WMD) because of the potential for international reprisal.<sup>4</sup> Nevertheless, one factor that could drive a need to innovate are the ideological convictions of VNSA leadership. Gary Ackerman posited that these proclivities for some VNSA leaders to pursue WMD efforts, despite the added risks of doing so, could be psychological or even fetishistic.<sup>5</sup>

---

<sup>3</sup> Tucker, Jonathan B. "Chapter 14: Lessons from the Case Studies." In *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, 267. Cambridge: MIT Press, 2000.

<sup>4</sup> Forest, James J.F. "Framework for Analyzing the Future Threat of WMD Terrorism." *Journal of Strategic Security* 5, no. 4 (2012): 51-68. Accessed June 21, 2021. <https://www.jstor.org/stable/26463973>

<sup>5</sup> Ackerman, Gary, and Michelle Jacome. "WMD Terrorism: The Once and Future Threat." *PRISM, Countering Weapons of Mass Destruction* 7, no. 3 (2018), 22-36. <https://www.jstor.org/stable/10.2307/26470532>. Pg. 24.

## “End of the World” Rationale

In some VNSA WMD pursuit's, apocalyptic millenarianism<sup>6</sup> can be a part of a VNSA leadership's decision-making. Some have argued the juxtaposition of apocalyptic motifs and WMD as being historically tied to the prevailing threat of nuclear annihilation during the Cold War and post-Cold War periods.<sup>7</sup> One of the most agreed upon instances of apocalyptic millenarianism is grounded in the Japanese terror group, Aum Shinrikyo, where the group's technical cadre pursued chemical and biological weapon efforts in order to satisfy their leader, Shoko Asahara's, vision of world-ending catastrophes.<sup>8</sup> ISIS having developed, weaponized, and used of chemical weapons,<sup>9</sup> also has been associated with apocalyptic millenarianism.<sup>10</sup> Theoretically, if VNSA leadership is ideologically driven to consider WMD pursuits then resources may be allocated accordingly to achieve a WMD end state. However, just because a VNSA is ideologically motivated to develop a WMD, does not mean they will be able to achieve this outcome.<sup>11</sup> Ackerman identifies that VNSAs with members that possess technical expertise, financial resources, logistics networks, secure production facilities, and safe haven are more likely to produce “higher-end” or advanced chemical warfare agents.<sup>12</sup>

---

<sup>6</sup> Apocalyptic millenarianism is defined as the “cross-cultural concept grounded in the expectation of a time of supernatural peace and abundance on earth” in conjunction with the “end times”. See “Millennialism | Definition, History, & Facts.” Encyclopedia Britannica. Accessed June 6, 2021.

<https://www.britannica.com/topic/millennialism>.

<sup>7</sup> Wojcik, Daniel. “Embracing Doomsday: Faith, Fatalism, and Apocalyptic Beliefs in the Nuclear Age.” *Western Folklore* 55, no. 4 (1996), 297. doi:10.2307/1500138. Pg. 298.

<sup>8</sup> Ibid. Pg. 325.

<sup>9</sup> Warrick, Joby. “How the Pentagon Got Inside ISIS’ Chemical Weapons Operation—and Ended It.” *POLITICO*. Last modified February 27, 2021. <https://www.politico.com/news/magazine/2021/02/27/red-line-book-excerpt-chemical-weapons-syria-471784>.

<sup>10</sup> Wood, Graeme. “What ISIS Really Wants.” *The Atlantic*. Last modified February 15, 2015.

<https://www.theatlantic.com/magazine/archive/2015/03/what-isis-really-wants/384980/>.

<sup>11</sup> Ackerman, Gary, and Michelle Jacome. “WMD Terrorism: The Once and Future Threat.” *PRISM, Countering Weapons of Mass Destruction* 7, no. 3 (2018), 22-36. <https://www.jstor.org/stable/10.2307/26470532>. Pg. 24.

<sup>12</sup> Ackerman, Gary A. “Anatomizing Chemical and Biological Non-State Adversaries.” *Calhoun: The NPS Institutional Archive*, January 2014, 1-355. <https://core.ac.uk/download/pdf/36738176.pdf>. Pg. 63-64.



## **The Importance of Safe Haven**

Michelle Jacome, Ackerman, and several other scholars in the field of WMD terrorism stipulate that safe havens afford VNSAs with the operational flexibility to pursue WMD efforts.<sup>13</sup> Jacome and Ackerman highlight that establishing safe haven allows VNSAs to engage in innovative engineering projects, drawing on historical examples of how the Provisional Irish Republican Army developed an indigenous mortar program or how the Revolutionary Armed Forces of Colombia (FARC) built submarines in Colombia's jungle.<sup>14</sup> What can be inferred is that safe haven is an instrumental factor in determining the relative success of a VNSA WMD effort, as it establishes a permissible operating environment.<sup>15</sup> Tucker echoes this sentiment by communicating:

“Groups that have developed toxic weapons in the past have typically enjoyed a permissive environment that provided time and space for experimentation.”<sup>16</sup>

## **Technical Expertise and Knowledge Types**

A recurring theme and debated topic within the body of scholarly research are the different types of technical expertise. Referring back to Tucker's sentiment in which most VNSAs tend to be conservative,<sup>17</sup> an argument made in the literature is that most VNSAs will decide not to pursue a WMD effort because of its complex or non-conservative characteristics. A significant hurdle that a VNSA faces is the steep learning curve associated with developing advanced agent

---

<sup>13</sup> Ackerman, Gary, and Michelle Jacome. "WMD Terrorism: The Once and Future Threat." *PRISM, Countering Weapons of Mass Destruction* 7, no. 3 (2018), 22-36. <https://www.jstor.org/stable/10.2307/26470532>. Pg. 32.

<sup>14</sup> *Ibid.* Pg. 32.

<sup>15</sup> *Ibid.* Pg. 32.

<sup>16</sup> Tucker, Jonathan B. "The Future of Chemical Weapons." *The New Atlantis*. Last modified September 26, 2020. <https://www.thenewatlantis.com/publications/the-future-of-chemical-weapons>.

<sup>17</sup> Tucker, Jonathan B. "Chapter 14: Lessons from the Case Studies." In *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, 267. Cambridge: MIT Press, 2000.

pursuits.<sup>18</sup> This is where the body of literature asserts that individuals selected to aid in a VNSA chemical weapon effort, as a requisite, should possess a significant degree of tacit and explicit technical knowledge.<sup>19</sup> Explicit knowledge is information that is readily accessible, easily understood, and transferrable; whereas tacit knowledge is more elusive as it tends to rely on a “hands on” understanding in a relevant field, making it harder to codify and difficult to transfer.<sup>20</sup> Where some scholars differ in their analysis on this issue is whether tacit knowledge is a requisite for a VNSA WMD effort. According to the Federation of American Scientists:

“The production of the nerve agents requires significantly more sophisticated chemical processing...If nerve agent production is technologically infeasible for a proliferant, a simpler agent (vesicant or classic agent) can be produced.”<sup>21</sup>

In effect, depending on resources and the types of technical expertise within the respective safe haven, a VNSA might consider a multitude of chemical agents of varying complexity. When considering the availability of these knowledge types, some VNSAs may use the internet for accessing open-source information on explicit knowledge sources.<sup>22</sup> Separately, VNSAs have also recruited professionally-trained chemists and engaged with consultants outside of the group in order to obtain the tacit knowledge required to achieve a chemical weapon status.<sup>23</sup>

---

<sup>18</sup> Ackerman, Gary, and Jeremy Tamsett. "Islamist Use and Pursuit of CBRN Terrorism." In *Jihadists and Weapons of Mass Destruction*, 339-340. Boca Raton: CRC Press, 2009.

<sup>19</sup> Ibid. Pg. 339-340.

<sup>20</sup> Jackson, Brian A., *Technology Acquisition by Terrorist Groups: Threat Assessment Informed by Lessons from Private Sector Technology Adoption*. Santa Monica, CA: RAND Corporation, 2001.

<https://www.rand.org/pubs/reprints/RP1248.html>. Pg. 8-9.

<sup>21</sup> "Federation of American Scientists: Chemical Weapons Production and Storage." Federation Of American Scientists – Science for a Safer, More Informed World. Last modified September 9, 2013.

<https://fas.org/programs/bio/chemweapons/production.html>.

<sup>22</sup> "The use of the Internet for terrorist purposes." United Nations Office on Drugs and Crime. Last modified 2012.

[https://www.unodc.org/documents/frontpage/Use\\_of\\_Internet\\_for\\_Terrorist\\_Purposes.pdf](https://www.unodc.org/documents/frontpage/Use_of_Internet_for_Terrorist_Purposes.pdf).

<sup>23</sup> Ackerman, Gary A.. "Comparative Analysis of VNSA Complex Engineering Efforts." *Journal of Strategic Security*9, no. 1 (2016) : 119-133. DOI: <http://dx.doi.org/10.5038/1944-0472.9.1.1511>

## Technology, Innovation, and Theory Considerations

Another series of scholarly work resides with assessing the future of WMD terrorism, which is identifiable, in part, with an ability to change approaches to technology. Gregory Koblentz and Ackerman posit that five-emerging technology concerns draw special consideration for chemical, biological, radiological, and nuclear (CBRN) weapons and how CBRN and these emerging technologies might be integrated and leveraged by VNSAs.<sup>24 25</sup> The emerging technologies include drones, the Dark Web, malware, synthetic biology, and additive manufacturing.<sup>26 27</sup> Koblentz and Ackerman identify with a narrative that places an emphasis on technologies that “de-skill” or make WMD efforts easier by removing tacit knowledge requirements.

The potential amalgamation of emerging technology and CBRN speaks to the ability for VNSAs to adopt innovative approaches in overcoming what used to be hurdles in chemical weaponization efforts. For example, the combined use of drones and chemical weapons, could provide the VNSA with an efficient means to deliver a chemical agent. According to Major Steven Hummel:

“In sum, the applicability to chemical weapons development of the technologies examined by this report lies primarily in unmanned aerial systems (UAS) use as a delivery mechanism. Chemical weapons material is relatively accessible, at least compared to biological weapons and nuclear material, so the critical hurdle in this category is effective delivery and dispersion... Given both the increasing advances in UAS capability and the innovative approach to

---

<sup>24</sup> Koblentz, Gregory D. "Emerging Technologies and the Future of CBRN Terrorism." *The Washington Quarterly* 43, no. 2 (2020), 177-196. doi:10.1080/0163660x.2020.1770969. Pg. 178-184.

<sup>25</sup> Ackerman, Gary, and Michelle Jacome. "WMD Terrorism: The Once and Future Threat." *PRISM, Countering Weapons of Mass Destruction* 7, no. 3 (2018), 22-36. <https://www.jstor.org/stable/10.2307/26470532>. Pg. 31.

<sup>26</sup> Koblentz, Gregory D. "Emerging Technologies and the Future of CBRN Terrorism." *The Washington Quarterly* 43, no. 2 (2020), 177-196. doi:10.1080/0163660x.2020.1770969. Pg. 178-184.

<sup>27</sup> Ackerman, Gary, and Michelle Jacome. "WMD Terrorism: The Once and Future Threat." *PRISM, Countering Weapons of Mass Destruction* 7, no. 3 (2018), 22-36. <https://www.jstor.org/stable/10.2307/26470532>. Pg. 31.

attack methodology and weapons development non-state actors have shown, this threat seems likely to grow”<sup>28</sup>

In effect, when we consider how emerging technology is growing to potentially encompass VNSA chemical weapon pursuits, this in part addresses Tucker’s consideration whereby a VNSA could see a need to innovate<sup>29</sup> at least in the sense of chemical weapon delivery systems, especially as we continue to observe how drones are becoming more prominent and established within VNSA groups.<sup>30</sup>

When considering a theoretical framework for VNSA WMD pursuits, James Forest, encapsulates the breadth of VNSA WMD factors within the confines of his practical and strategic constraint theories.<sup>31</sup> These theories take into account VNSA WMD factors but also attempt to discuss why most VNSAs decide not pursue WMD or chemical weapon efforts. Practical constraint theory can be broken down into technical and environmental considerations, where the complexity of the WMD pursuit is inversely correlated to the success of the attack.<sup>32</sup> Within the technical considerations category we can align this with technical expertise. Environmental considerations are identifiable with safe haven, funding, access to production facilities, and an ability to change approaches to technology. According to Forest, an increase in the complexity of a WMD effort, combined with higher financial costs and the number of required technical experts becomes an

---

<sup>28</sup> Hummel, Stephen. "Small Groups, Big Weapons: The Nexus of Emerging Technologies and Weapons of Mass Destruction Terrorism." Combating Terrorism Center at West Point. Last modified April 2, 2020. <https://www.ctc.usma.edu/small-groups-big-weapons-the-nexus-of-emerging-technologies-and-weapons-of-mass-destruction-terrorism/>.

<sup>29</sup> Tucker, Jonathan B. "Chapter 14: Lessons from the Case Studies." In *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, 267. Cambridge: MIT Press, 2000.

<sup>30</sup> Warrick, Joby. "Use of weaponized drones by ISIS spurs terrorism fears." The Washington Post. Last modified February 21, 2017. [https://www.washingtonpost.com/world/national-security/use-of-weaponized-drones-by-isis-spurs-terrorism-fears/2017/02/21/9d83d51e-f382-11e6-8d72-263470bf0401\\_story.html](https://www.washingtonpost.com/world/national-security/use-of-weaponized-drones-by-isis-spurs-terrorism-fears/2017/02/21/9d83d51e-f382-11e6-8d72-263470bf0401_story.html).

<sup>31</sup> Forest, James J.F. "Framework for Analyzing the Future Threat of WMD Terrorism." *Journal of Strategic Security* 5, no. 4 (2012): 51-68. Accessed June 21, 2021. <https://www.jstor.org/stable/26463973>

<sup>32</sup> *Ibid.* Pg. 54-55.

increasing cause for concern for a VNSA group.<sup>33</sup> The rationale for this resides with an increased risk for operational failure or a misallocation of resources:

“Overall, there are many kinds of technical challenges associated with CBRN weapons. These challenges, in turn, influence a terrorist group's decision-making about whether to invest resources in trying to develop or acquire them for use.”<sup>34</sup>

Figure 1 illustrates Forest's practical constraint theory:<sup>35</sup>

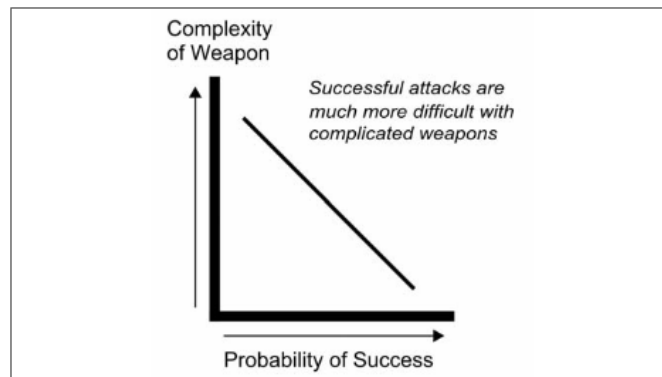


Figure 1: Technical Complexity and Success Rate<sup>36</sup>

The upper left portion of this scale where the complexity of the weapon is high and the probability of success is low can be identifiable with a relatively sophisticated or advanced WMD pursuit. Conversely, the lower right portion of the scale where the complexity of the weapon is lower but the success rate is higher might be attributable to relatively crude WMD efforts.

Forest's strategic constraint theory considers the VNSA WMD factor associated with leadership endorsement. Forest stipulates that VNSA groups tend to be rational in their decision-making

<sup>33</sup> Forest, James J.F. "Framework for Analyzing the Future Threat of WMD Terrorism." *Journal of Strategic Security* 5, no. 4 (2012): 54-55. Accessed June 21, 2021. <https://www.jstor.org/stable/26463973>

<sup>34</sup> *Ibid.* Pg. 56.

<sup>35</sup> *Ibid.* Pg. 55.

<sup>36</sup> *Ibid.* Pg. 55.

capacity, and when taking into account practical constraints will at times consider whether WMD or chemical weapon efforts are worth pursuing:

“For example, a terrorist group's leaders may ask themselves, ‘Will a CBRN weapon help us achieve our objectives faster or more effectively than other means? Will the possession or use of such a weapon bring us a considerable amount of prestige and/or power to intimidate our enemies?’ For most terrorist groups, their strategic deliberations have steered them away from CBRN weapons.”<sup>37</sup>

Decision-making also takes into account how WMD or chemical weapon pursuits might not help achieve political objectives because of the prospect of damaging what Forest refers to as the “space and people they seek to influence and govern.”<sup>38</sup> However, Forest also alludes to the idea that ideological considerations of an “us versus them” mentality for some VNSAs could expand weapon pursuits to include chemical weapon efforts.<sup>39</sup>

When we consider how practical constraint theory and strategic constraint theory come together, Forest identifies that most VNSAs face high practical constraints and high strategic constraints; i.e., they do not have the factors necessary for a WMD or chemical weapon pursuit.<sup>40</sup> There are also instances where a group might have fewer practical constraints but more strategic constraints or vice versa. For instance, a group could have factors such as technical experts, funding, safe haven, and production facilities but leadership is not willing to endorse WMD or chemical weapon efforts.<sup>41</sup> Lastly, there are those rare instances where a VNSA might have low

---

<sup>37</sup> Forest, James J.F. "Framework for Analyzing the Future Threat of WMD Terrorism." *Journal of Strategic Security* 5, no. 4 (2012): 57. Accessed June 21, 2021. <https://www.jstor.org/stable/26463973>

<sup>38</sup> *Ibid.* Pg. 58.

<sup>39</sup> *Ibid.* Pg. 58.

<sup>40</sup> *Ibid.* Pg. 60-61.

<sup>41</sup> *Ibid.* Pg. 60-61.

practical and strategic constraints, meaning the group could have all factors necessary to pursue a WMD or chemical weapon effort.<sup>42</sup>

The following figure illustrates both practical constraint theory and strategic constraint theory considerations:

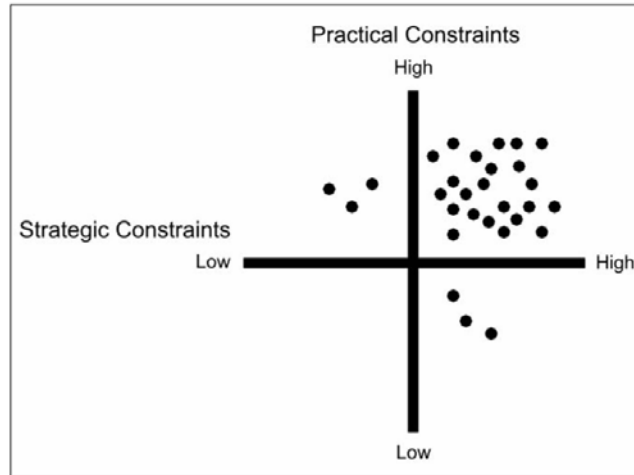


Figure 2: Practical Constraint Theory and Strategic Constraint Theory Considerations<sup>43</sup>

## Way Forward

This paper aims to expand on the body of scholarly works addressing VNSA chemical weapon efforts by not only concentrating on a historical case of VNSA chemical weapon use but also to see where key distinctions lie with more contemporary examples. Having considered the range of scholarly research, an argument can be made that the factors that impact the development and use of chemical weapons by VNSAs are securing safe haven, having technical experts, proper finances, access to production facilities, leadership endorsement, and an ability to change

---

<sup>42</sup> Forest, James J.F. "Framework for Analyzing the Future Threat of WMD Terrorism." *Journal of Strategic Security* 5, no. 4 (2012): 60-61. Accessed June 21, 2021. <https://www.jstor.org/stable/26463973>

<sup>43</sup> *Ibid.* Pg. 60-61.

approaches to technology – with the most critical factors being safe haven and an ability to change approaches to technology.

For the purpose of this study, safe haven will be defined as followed:

“Terrorist safe havens described in this report include ungoverned, under-governed, or ill-governed physical areas where terrorists are able to organize, plan, raise funds, communicate, recruit, train, transit, and operate in relative security because of inadequate governance capacity, political will, or both.”<sup>44</sup>

Our definition for “an ability to change approaches to technology” can be highlighted as “knowledge applied for a practical purpose in order to affect and control the user’s environment”<sup>45</sup> and often involves “material objects, as well as systems, processes and techniques, but is always purposive.”<sup>46</sup> Other factors are self-explanatory and do not require explicit definitions. These attributes will be placed into greater context later in the paper.

## **Hypothesis and Methods**

This paper has examined some of the existing literature related to VNSA pursuits and the factors involved in determining the effectiveness of a chemical weapon effort. As such, this paper asks the following research question: What factors impact the development and use of chemical weapons by VNSAs? The hypothesis for this study is that an increase in available safe haven or an ability to change approaches to technology makes a VNSA chemical weapon effort more likely.

---

<sup>44</sup> "Country Reports on Terrorism 2019." United States Department of State. Last modified June 24, 2020. <https://www.state.gov/reports/country-reports-on-terrorism-2019/>.

<sup>45</sup> Gary A. Ackerman, "'More Bang for the Buck': Examining the Determinants of Terrorist Adoption of New Weapons Technologies" (Ph.D. Dissertation: King's College London, 2014), pp. 19.

<sup>46</sup> Ibid. Pg. 19.



In order to test this claim, a comparative case study will be conducted by examining the actions taken by Aum Shinrikyo and ISIS. By comparing two significant VNSAs who have both demonstrated chemical weapon efforts, insight will be gleaned by examining each of these factors respective to these groups. An important consideration when conducting this research study was to understand that a conventional VNSA engineering effort could also align with the factors that we've established. For example, as previously identified the FARC constructed "Narco-sub" using the Columbian jungle as a safe haven but never considered chemical weapons.<sup>47</sup> Although VNSAs may share common factors, such as safe haven, while pursuing different innovative projects (i.e. conventional v. chemical weapon efforts), the deciding factor between projects often resides with leadership intentions and the general motives associated with the VNSA.<sup>48</sup> Additionally, there may be confluence in other factors that could be indicative of a VNSA chemical weapon effort, instead of a conventional one. For example, the VNSA could attempt to acquire chemical weapon precursors while simultaneously recruiting professional chemists. We will expound on this facet of differentiating between conventional and chemical weapon efforts later in the paper.

The following chart will be referenced throughout the study for assessing the VNSA group and chemical weapon factors.

<b>Factors</b>	<b>Aum Shinrikyo</b>	<b>ISIS</b>
<b>Possessed Safe Haven</b>		
<b>Possessed Technical Experts</b>		
<b>Possessed Funding</b>		
<b>Possessed Access to Production Facilities</b>		

<sup>47</sup> Gary A. Ackerman, "'More Bang for the Buck': Examining the Determinants of Terrorist Adoption of New Weapons Technologies" (Ph.D. Dissertation: King's College London, 2014), pp. 32.

<sup>48</sup> Ackerman, Gary A. "Comparative Analysis of VNSA Complex Engineering Efforts." *Journal of Strategic Security* 9, no. 1 (2016) : 119-133. DOI: <http://dx.doi.org/10.5038/1944-0472.9.1.1511>

<b>Possessed Leadership Enabled Endorsement</b>		
<b>Possessed an Ability to Change Approaches to Technology</b>		

The independent variables will be the factors associated with the VNSA chemical weapon effort. The dependent variables will be the acquisition of chemical weapons by the VNSA. The reason why Aum Shinrikyo and ISIS have been selected is because these groups appear to be the most “successful” in the demonstrated production and use of chemical weapons. This “success” can be qualified by Aum Shinrikyo being able to produce “significant quantities of sarin” and ISIS using chlorine and sulfur mustard dozens of times on the battlefield in Iraq and Syria.<sup>49</sup> Other groups by comparison have not been able to achieve either this scale of agent complexity or large-scale use. The justification for excluding a group like al Qaeda from this study was because cursory research identified that al Qaeda leadership deemed chemical weaponization efforts inappropriate. According to Rolf Mowatt-Larsen:

“The evidence of al Qaeda’s efforts to acquire WMD for over a decade overwhelmingly suggests that the senior leadership’s intent is focused on developing high end WMD, not chemical weapons or “dirty bombs” that lack the game changing qualities of nuclear or biological weapons. In this context, a possible explanation of Zawahiri’s puzzling cancellation of a small-scale chemical attack on the New York City subway in 2003 is that it simply wasn’t worth doing.”<sup>50</sup>

Additionally, it can be argued that Aum Shinrikyo is the quintessential “baseline” from which to compare other VNSA chemical weapon efforts because the group was able to successfully

---

<sup>49</sup> Hummel, Stephen. "Small Groups, Big Weapons: The Nexus of Emerging Technologies and Weapons of Mass Destruction Terrorism." Combating Terrorism Center at West Point. Last modified April 2, 2020. <https://www.ctc.usma.edu/small-groups-big-weapons-the-nexus-of-emerging-technologies-and-weapons-of-mass-destruction-terrorism/>.

<sup>50</sup> Rolf Mowatt-Larsen, *Islam and the Bomb: Religious Justification For and Against Nuclear Bombs* (Massachusetts: Belfer Center for Science and International Affairs, 2011), Pg. 20.

develop and use the nerve agent sarin – a moderately difficult chemical agent to produce. Upon successfully collecting data pertaining to these VNSAs and the factors associated with their chemical weapon efforts, a discussion component will be initiated to highlight important distinctions between the VNSA and their respective chemical weapon effort factors. This study will not employ quantitative methods because it would be difficult to collect measurable attributes associated with the factors. For example, attempting to find quantitative data when considering leadership endorsement. In terms of trying to determine if the hypothesis is correct, a comparative case study will be conducted against ISIS and Aum Shinrikyo, whereby a determination will be made as to whether each factor was represented or impactful to the respective chemical weapon efforts. These variables will be operationalized with a designator of “no,” “somewhat,” and “yes.” The expectation is that safe haven and an ability to change approaches to technology will be the most critical factors. When determining how critical a factor is some of these attributes are foundational or allow other factors to become realized. For example, once a VNSA secures safe haven, they may be able to build chemical weapon production facilities, recruit technical experts, or fund operations because of the perceived permissible operating environment. Another expectation is how some of these factors will be “necessary” or “sufficient” depending on the chemical weapon effort itself. For example, in the pursuit of an advanced agent, such as sarin, all VNSA chemical weapon factors could be characterized as “necessary”. However, in the pursuit of a simpler agent, such as chlorine or hydrogen sulfide, there may be a shift from “necessary” to “sufficient”, where there might not be as much of a need for safe haven, production facilities, or technical experts. The evidence gathered to evaluate these claims will be from scholarly articles, narratives from select personnel associated with the group’s chemical weapon efforts, news publications, and public statements

made by these organizations. This paper will conclude with a comparative analysis and suggestions as to how to improve counterproliferation and counter-WMD efforts.

### **Data Acquisition: ISIS and Aum Shinrikyo Timeline of VNSA Chemical Weapon Factors**

The following timeline provides a summary of key events for ISIS and Aum Shinrikyo’s chemical weapon efforts. Later data acquisition sections will provide additional context as to how these events relate to the VNSA chemical weapon factors:

<b>Aum Shinrikyo</b>	<b>ISIS</b>
Mid-1980s to Early 1990s: Establishment of “Lotus Villages”, the purchase of 14 acres in Namino, and communes built at Fujinomiya, near Mount Fuji. (Safe Haven) <sup>51</sup>	1999: Abu Mus’ab al Zaraqawi, the leader of al Qaeda in Iraq (AQI), established training camps in Afghanistan and experimented with toxins and poisons. <sup>52</sup> By 2006, these chemical weapon efforts would become more sophisticated. (Leadership Endorsement/Safe Haven) <sup>53</sup>
1985 to 1989: Shoko Asahara shifts from peace and enlightenment to apocalyptic millenarianism motifs as central premise. (Leadership Endorsement) <sup>54</sup>	2005: ISIS technical expert, Abu Malik, long time Salafi jihadist allegedly involved in ISIS’s planning efforts to produce chemical weapons. <sup>55</sup> Abu Malik associated with Saddam Regime chemical weapon efforts. (Technical Experts) <sup>56</sup>

<sup>51</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 8-17.

<sup>52</sup> Strack, Columb. "The Evolution of the Islamic State’s Chemical Weapons Efforts – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified January 12, 2018.

<https://www.ctc.usma.edu/the-evolution-of-the-islamic-states-chemical-weapons-efforts/>.

<sup>53</sup> Ibid.

<sup>54</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 13.

<sup>55</sup> "ISIS Chemical Weapons Expert ‘killed’ in Airstrike." Al Arabiya English. Last modified May 20, 2020.

<https://english.alarabiya.net/News/middle-east/2015/01/31/U-S-Coalition-strike-kills-ISIS-chemical-weapons-expert->

<sup>56</sup> Joscelyn, Thomas. "US Designates ISIS Chemical Weapons Expert from France As Terrorist." FDD's Long War Journal. Last modified March 22, 2018. <https://www.longwarjournal.org/archives/2018/03/us-designates-isis-chemical-weapons-expert-from-france-as-terrorist.php>.

1993: Group reaches inflection point; experts set up bench scale laboratory and succeed in producing gram quantities of sarin. <sup>57</sup> (Technical Experts)	2011 to 2014: Seize territory in Syria and Iraq. (Safe Haven) <sup>58</sup>
1993: Production facility Satyan 7 established. (Production Facilities) <sup>59</sup>	2015: Abu Malik dies. (Technical Experts) <sup>60</sup>
1993: Discussion held to equip forces with plasma and X-Ray weapons. (An Ability to Change Approaches to Technology) <sup>61</sup>	2014 to 2017: At the height of ISIS's chemical weapon use <sup>62</sup> its revenue is estimated (in \$million) to be 970-1890 in 2014, 1035-1700 in 2015, 520-870 in 2016. (Funding) <sup>63</sup>
Early-1990s: At height, group's financial assets reach as much as 2 billion USD. (Funding) <sup>64</sup>	2014 to 2017: Unspecified number of production sites exist. (Production Facilities) <sup>65</sup>
March 1995: Tokyo subway sarin attack. <sup>66</sup>	2014 to 2017: Chemical weapon attacks conducted in Iraq and Syria. <sup>67</sup>

<sup>57</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, "Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons," Centers for a New American Security, July 2011: Pg. 21.

<sup>58</sup> "The War Against 'Islamic State' in Maps and Charts." BBC News. Last modified March 28, 2018. <https://www.bbc.com/news/world-middle-east-27838034>.

<sup>59</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, "Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons," Centers for a New American Security, July 2011: Pg. 27.

<sup>60</sup> Warrick, Joby. "How the Pentagon Got Inside ISIS' Chemical Weapons Operation—and Ended It." POLITICO. Last modified February 27, 2021. <https://www.politico.com/news/magazine/2021/02/27/red-line-book-excerpt-chemical-weapons-syria-471784>.

<sup>61</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, "Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons," Centers for a New American Security, July 2011: Pg. 20.

<sup>62</sup> Strack, Columb. "The Evolution of the Islamic State's Chemical Weapons Efforts – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified January 12, 2018. <https://www.ctc.usma.edu/the-evolution-of-the-islamic-states-chemical-weapons-efforts/>.

<sup>63</sup> Heibner, Stefan, Peter Neumann, John Holland-McCowan, and Rajan Basra. "Caliphate in Decline: An Estimate of Islamic State's Financial Fortunes." The International Centre for the Study of Radicalisation and Political Violence, 2017, 1-20.

<sup>64</sup> "THE TRANSNATIONAL THREAT." Federation Of American Scientists – Science for a Safer, More Informed World. Accessed June 16, 2021. <https://fas.org/irp/threat/prolif97/trans.html>.

<sup>65</sup> Strack, Columb. "The Evolution of the Islamic State's Chemical Weapons Efforts – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified January 12, 2018. <https://www.ctc.usma.edu/the-evolution-of-the-islamic-states-chemical-weapons-efforts/>.

<sup>66</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, "Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons," Centers for a New American Security, July 2011: Pg. 19.

<sup>67</sup> Strack, Columb. "The Evolution of the Islamic State's Chemical Weapons Efforts – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified January 12, 2018. <https://www.ctc.usma.edu/the-evolution-of-the-islamic-states-chemical-weapons-efforts/>.

	2017: Australian ISIS bomb plot; secondary plot reveals plans of a toxic gas attack against public transit. (An Ability to Change Approaches to Technology) <sup>68</sup>
	Late 2017: ISIS loses nearly all territorial claims in Iraq and Syria. <sup>69</sup>
	January 2020: ISIS Spokesman publicly endorses chemical weapon attacks. (Leadership Endorsement) <sup>70</sup>

**Data Acquisition: Safe Haven**

In the mid-1980’s, the leader of Aum Shinrikyo, Shoko Asahara, established communes known as “Lotus Villages” which would form the basis of his group’s perceived utopic society.<sup>71</sup> As the group gained more followers, the number of communes or safe haven increased accordingly.<sup>72</sup> By 1989, Asahara’s group undertook instrumental measures to insulate itself from state interference and reinforce their safe havens by appealing to the Tokyo Prefecture under the auspices of the Religious Corporations Law.<sup>73</sup> Upon being approved as a legal religious body, Aum Shinrikyo by mid-1990 would further increase property acquisitions for the purpose of producing chemical weapons. According to the Centers for a New American Security:

“The rapid expansion of Aum required more communal facilities. Therefore, in May 1990, Hayakawa, using dummy companies, bought 14 acres in Namino...Unknown to the police, local residents or even most Aum members,

---

<sup>68</sup> McKirdy, Euan, and Karen Smith. "Foiled Plot to Blow Up Plane, Unleash Gas Revealed in Australia." CNN. Last modified August 5, 2017. <https://www.cnn.com/2017/08/03/asia/australia-plane-terror-plot-isis/index.html>.  
<sup>69</sup> "Timeline: the Rise, Spread, and Fall of the Islamic State." Wilson Center. Accessed July 5, 2021. <https://www.wilsoncenter.org/article/timeline-the-rise-spread-and-fall-the-islamic-state>.  
<sup>70</sup> JERUSALEM POST STAFF. "ISIS Calls on Operatives to Target Jews with Chemical Weapons." The Jerusalem Post | JPost.com. Last modified January 28, 2020. <https://www.jpost.com/breaking-news/isis-we-need-to-conquer-israeli-settlements-start-targeting-jews-615535>.  
<sup>71</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 8.  
<sup>72</sup> Ibid. Pg. 9.  
<sup>73</sup> Ibid. Pg. 13.

the cult's desire for land and buildings reflected Asahara's desire to manufacture chemical weapons.”<sup>74</sup>

Between 2011 and 2014, ISIS engaged in a multipronged strategy that saw the group join in the conflict against the Syrian regime, take advantage of the US troop withdrawal, stoke sectarian violence, and begin seizing territory in Syria and Iraq.<sup>75</sup> As the group began seizing territory, they were effectively able to operate permissibly, providing the group with sufficient time and space to pursue a number of civil and military projects.<sup>76</sup>

With territorial claims established by 2014, some of the group's military projects included chlorine and sulfur mustard use.<sup>77</sup> Joby Warrick provided insight on this subject and identified what a permissible operating environment or safe haven allowed ISIS to pursue:

“Obtaining chlorine was no problem, as the industrial chemical could be found in Iraqi factories the terrorists now controlled. But what about sulfur mustard? The lab tests and interviews yielded a confirmation, and also a surprise. The oily liquid in the mortar shells was sulfur mustard, no doubt, but it differed from the kinds of military-grade blister agents the OPCW's experts were familiar with. Its formula was relatively simple, even crude.”<sup>78</sup>

---

<sup>74</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 17.

<sup>75</sup> “The War Against ‘Islamic State’ in Maps and Charts.” BBC News. Last modified March 28, 2018. <https://www.bbc.com/news/world-middle-east-27838034>.

<sup>76</sup> “MMP: Islamic State.” FSI | CISAC - CISAC. Accessed June 15, 2021. [https://cisac.fsi.stanford.edu/mappingmilitants/profiles/islamic-state#highlight\\_text\\_12400](https://cisac.fsi.stanford.edu/mappingmilitants/profiles/islamic-state#highlight_text_12400).

<sup>77</sup> Warrick, Joby. “How the Pentagon Got Inside ISIS’ Chemical Weapons Operation—and Ended It.” POLITICO. Last modified February 27, 2021. <https://www.politico.com/news/magazine/2021/02/27/red-line-book-excerpt-chemical-weapons-syria-471784>.

<sup>78</sup> Warrick, Joby. “How the Pentagon Got Inside ISIS’ Chemical Weapons Operation—and Ended It.” POLITICO. Last modified February 27, 2021. <https://www.politico.com/news/magazine/2021/02/27/red-line-book-excerpt-chemical-weapons-syria-471784>.

## Data Acquisition: Technical Experts

After a series of failed biological weapon pursuits, Aum Shinrikyo then decided to pursue a chemical weapon effort.<sup>79</sup> Under the supervision of Hideo Murai, sarin was deemed the most optimal agent because of its relative cost effectiveness.<sup>80</sup> Although Murai was in charge of the initiative, as Aum Shinrikyo's Minister of Science and Technology,<sup>81</sup> the individual who had made the suggestion to Murai to pursue a sarin weaponization effort was Masami Tsuchiya, an organic chemist.<sup>82</sup> By mid-1993, Tsuchiya reached an inflection point for the group, by setting up a bench scale laboratory and succeeded in producing gram quantities of sarin.<sup>83</sup>

As of early 2021, it was confirmed ISIS had produced significant quantities of sulfur mustard while holding territory in Iraq and Syria.<sup>84</sup> The technical expert most likely responsible for helping ISIS get a chemical weapon effort started was Salih Jasim Mohammed Falah al-Sabawi, also known as Abu Malik.<sup>85</sup> Abu Malik, a long time Salafi jihadist had ties to ISIS going back to 2005 when the group operated under the auspices of AQI and had allegedly been involved in AQI's planning efforts to produce chemical weapons.<sup>86</sup> Abu Malik has also been reported to have "worked at Saddam Hussein's Muthanna chemical weapon production facility before affiliating with al Qaeda in Iraq in 2005," according to a US Central Command press release

---

<sup>79</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, "Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons," Centers for a New American Security, July 2011: Pg. 24-27.

<sup>80</sup> Ibid. Pg. 27.

<sup>81</sup> Ibid. Pg. 10-12.

<sup>82</sup> Ibid. Pg. 27.

<sup>83</sup> Ibid. Pg. 27.

<sup>84</sup> Warrick, Joby. "How the Pentagon Got Inside ISIS' Chemical Weapons Operation—and Ended It." POLITICO. Last modified February 27, 2021. <https://www.politico.com/news/magazine/2021/02/27/red-line-book-excerpt-chemical-weapons-syria-471784>.

<sup>85</sup> "ISIS Chemical Weapons Expert 'killed' in Airstrike." Al Arabiya English. Last modified May 20, 2020. <https://english.alarabiya.net/News/middle-east/2015/01/31/U-S-Coalition-strike-kills-ISIS-chemical-weapons-expert->

<sup>86</sup> Ibid.



statement.<sup>87</sup> The Muthanna chemical weapon production facility was a key compound for developing offensive agents, including sarin and mustard gas.<sup>88</sup> However, most resourcing at this production site was allocated primarily to the production of sulfur mustard.<sup>89</sup> Therefore, it may be inferred that Abu Malik played an instrumental role in helping ISIS to develop their own indigenous means of producing sulfur mustard.

Abu Malik was supported by a number of technical experts, including Suleiman al-Afari, which allowed ISIS to continue to pose a chemical weapon threat following Abu Malik's death in 2015.

<sup>90</sup> As revealed in Joby Warrick's exposé on the group's chemical weapon effort:

“The CIA and the Defense Department were now working to disrupt the Islamic State's weapons program, and they already had achieved a crucial success: the killing of Abu Malik, Afari's ISIS boss. Alarmed by the engineer's talk about gassing Western cities, the Pentagon quietly dispatched special-forces teams into Iraq to find him, and then ordered an airstrike that obliterated his Mosul office. Abu Malik was dead, but as Afari's confessions revealed, ISIS had not given up. Newcomers, including foreign scientists, had been tapped to fulfill Abu Malik's terrible vision.”<sup>91</sup>

Suleiman al-Afari was a geologist who was previously employed with Iraq's Ministry of Industry and Minerals.<sup>92</sup> Afari was assigned to ISIS's metallurgical division, where he acquired

---

<sup>87</sup> Joscelyn, Thomas. "US Designates ISIS Chemical Weapons Expert from France As Terrorist." FDD's Long War Journal. Last modified March 22, 2018. <https://www.longwarjournal.org/archives/2018/03/us-designates-isis-chemical-weapons-expert-from-france-as-terrorist.php>.

<sup>88</sup> "ISIS Chemical Weapon Specialist Was 'Gathering Equipment' Before He Was Killed." The Daily Beast. Last modified January 31, 2015. <https://www.thedailybeast.com/isis-chemical-weapon-specialist-was-gathering-equipment-before-he-was-killed>.

<sup>89</sup> Ibid.

<sup>90</sup> Warrick, Joby. "How the Pentagon Got Inside ISIS' Chemical Weapons Operation—and Ended It." POLITICO. Last modified February 27, 2021. <https://www.politico.com/news/magazine/2021/02/27/red-line-book-excerpt-chemical-weapons-syria-471784>.

<sup>91</sup> Ibid.

<sup>92</sup> Warrick, Joby. "Exclusive: Iraqi scientist says he helped ISIS make chemical weapons." The Washington Post. Last modified January 21, 2019. [https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd\\_story.html?noredirect=on](https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd_story.html?noredirect=on).

stainless steel tanks and corrosive and heat resistant piping.<sup>93</sup> Afari revealed that these acquisitions were necessary because of the caustic characteristics associated with the crude sulfur mustard agent the group had been producing.<sup>94</sup>

### **Data Acquisition: Funding**

According to the Center for a New American Security, early periods of Aum Shinrikyo obligated new entrants into the organization to give donations and renounce materialism:

“Novices were urged to give donations for initiation and gradually to renounce the materialist and spiritually void society (symbolized by the United States) that was inevitably heading toward catastrophe.”<sup>95</sup>

After having established safe haven, Aum Shinrikyo was able to gain exposure to several industries and businesses via its member’s holdings.<sup>96</sup> Some of these existing industries were in the fields of software development, imports/exports, mining, and chemicals; some of which were complicit in the development of Aum Shinrikyo’s sarin effort.<sup>97</sup> Additionally, some of these firms were used as shell companies when the group increased sarin production capacity:

“To purchase the required technical equipment and substantial amounts of chemicals, Aum created two dummy companies – both run by Niimi – under Hasegawa Chemical, an already existing Aum shell company.”<sup>98</sup>

---

<sup>93</sup> Warrick, Joby. "Exclusive: Iraqi scientist says he helped ISIS make chemical weapons." The Washington Post. Last modified January 21, 2019. [https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd\\_story.html?noredirect=on](https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd_story.html?noredirect=on).

<sup>94</sup> Ibid.

<sup>95</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 8.

<sup>96</sup> "Aum Shinrikyo (Aleph)." The Mackenzie Institute. Accessed June 16, 2021. <https://mackenzieinstitute.com/2015/12/aum-shinrikyo-aleph/>.

<sup>97</sup> "Aum Shinrikyo (Aleph)." The Mackenzie Institute. Accessed June 16, 2021. <https://mackenzieinstitute.com/2015/12/aum-shinrikyo-aleph/>.

<sup>98</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 28.

According to the Federation of American Scientists, Aum Shinrikyo at its height in the early 1990s had accrued assets worth an estimated \$2 billion.<sup>99</sup>

At the height of ISIS’s territorial control and chemical weapon use between 2014 and 2017,<sup>100</sup> its revenue was broken down as followed: taxes, natural resources, kidnapping, antiquities, foreign donations, and looting.<sup>101</sup> The following chart published by the International Centre for the Study of Radicalization and Political Violence provides greater fidelity in terms of how ISIS was financed during this period:<sup>102</sup>

	2014 (in \$m)	2015 (in \$m)	2016 (in \$m)
Taxes and Fees	300–400	400–800	200–400
Oil	150–450	435–550	200–250
Kidnapping	20–40	Not known	10–30
Antiquities	Not known	Not known	Not known
Foreign Donations	Insignificant	Insignificant	Insignificant
Looting, Confiscations, Fines	500–1,000	200–350	110–190
<b>TOTAL</b>	<b>970–1,890</b>	<b>1,035–1,700</b>	<b>520–870</b>

Figure 3: ISIS Revenue 2014-2016<sup>103</sup>

<sup>99</sup> "THE TRANSNATIONAL THREAT." Federation Of American Scientists – Science for a Safer, More Informed World. Accessed June 16, 2021. <https://fas.org/irp/threat/prolif97/trans.html>.

<sup>100</sup> Strack, Columb. "The Evolution of the Islamic State’s Chemical Weapons Efforts – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified January 12, 2018.

<https://www.ctc.usma.edu/the-evolution-of-the-islamic-states-chemical-weapons-efforts/>.

<sup>101</sup> Heibner, Stefan, Peter Neumann, John Holland-McCowan, and Rajan Basra. "Caliphate in Decline: An Estimate of Islamic State’s Financial Fortunes." The International Centre for the Study of Radicalisation and Political Violence, 2017, 1-20.

<sup>102</sup> Ibid. Pg. 9.

<sup>103</sup> Heibner, Stefan, Peter Neumann, John Holland-McCowan, and Rajan Basra. "Caliphate in Decline: An Estimate of Islamic State’s Financial Fortunes." The International Centre for the Study of Radicalisation and Political Violence, 2017, 9.

## Data Acquisition: Production Facilities

By 1993, Aum Shinrikyo decided there was a need for a dedicated large-scale production facility for sarin manufacturing—identified as Satyan 7.<sup>104</sup> This need was attributed to the quantity of agent requested, where bench or small-scale production efforts would not suffice.<sup>105</sup> It is important to note that Aum’s technical experts displayed hesitation when going from small to industrial scale, noting the increase in difficulty.<sup>106</sup> As a side note, this attempt to increase sarin production capacity aligns with practical constraint theory’s environmental considerations:<sup>107</sup>

“After Tsuchiya’s successful production of small quantities of sarin, Murai ordered Tsuchiya to make about 70 tons of the chemical. Tsuchiya says he responded that he was reluctant to produce such a large amount. Under any conditions, there was a practical difficulty. Tsuchiya was a research scientist; large batches would require constructing and administering a production facility, not just a research lab.”<sup>108</sup>

---

<sup>104</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 27.

<sup>105</sup> Ibid. Pg. 20.

<sup>106</sup> Ibid. Pg. 20.

<sup>107</sup> Forest, James J.F. "Framework for Analyzing the Future Threat of WMD Terrorism." *Journal of Strategic Security* 5, no. 4 (2012): 51-68. Accessed June 21, 2021. <https://www.jstor.org/stable/26463973>

<sup>108</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 20.



Separately, smaller scale ISIS production efforts probably took place at Mosul University for the purpose of R&D, which was within their territorial control or deemed safe haven at the time.

According to the UN Investigative Team to Promote Accountability for Crimes Committed by Da'esh:

“Islamic State leaders recruited scientists and engineers — a mix of foreign experts and veterans of former Iraqi leader Saddam Hussein’s chemical weapons factories — to help them produce sulfur mustard, using the laboratories of Mosul University as a research hub.”<sup>113</sup>

### **Data Acquisition: Leadership Endorsement**

Shoko Asahara, under the auspices of helping his followers achieve spiritual enlightenment initially began the organization with peace as an overarching objective.<sup>114</sup> Asahara’s charismatic personality would captivate a number of individuals, many of whom were students gifted in the fields of chemistry, physics, and biology.<sup>115</sup> From 1985 to 1989, Asahara would shift from peace and enlightenment to delusions of grandeur, asserting he was a hero or God responsible for saving humanity by tapping into apocalyptic millenarianism motifs as the central premise.<sup>116</sup> The tipping point for Asahara and Aum Shinrikyo that would eventually drive it to pursue chemical weapon efforts would manifest in an electoral race<sup>117</sup>. According to the Centers for a New American Security:

---

<sup>113</sup> Warrick, Joby. "ISIS used chemical weapons on Iraqi prisoners, U.N. investigators find." The Washington Post. Last modified May 13, 2021. [https://www.washingtonpost.com/national-security/isis-chemical-weapons-experiments-mosul/2021/05/13/bbfefb0-b42e-11eb-a980-a60af976ed44\\_story.html](https://www.washingtonpost.com/national-security/isis-chemical-weapons-experiments-mosul/2021/05/13/bbfefb0-b42e-11eb-a980-a60af976ed44_story.html).

<sup>114</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 7.

<sup>115</sup> Ibid. Pg. 10-11.

<sup>116</sup> Ibid. Pg. 13.

<sup>117</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 7.

“Asahara reasoned that if he failed to gain control of the state through elections, then this was again a sign of God, and he would go ahead with his plan of destruction.”<sup>118</sup>

Having failed to gain any form of state control, Asahara and Aum Shinrikyo would follow through with efforts to enact the “plan of destruction” that was prophesized by Asahara.<sup>119</sup>

In the case of ISIS, there is a significant history of chemical weapon intent but direct leadership endorsement is tenuous. In 1999, Abu Mus’ab al Zarqawi, the leader of the predecessor organization to ISIS, al Qaeda in Iraq (AQI), established training camps in Afghanistan and began experimenting with toxins and poisons.<sup>120</sup> By 2006, these chemical weapon efforts would become more sophisticated, employing a combination of vehicle-borne improvised explosive devices and chlorine.<sup>121</sup> By 2013, further progress was made with an alleged combined use of remote-controlled helicopters and unspecified chemical agents, just a couple years shy of a sustained ISIS campaign of chemical weapon use in Iraq and Syria.<sup>122</sup>

Although ISIS chemical weapon experts and supporter elements are identified, there is a gap in the evidence directly linking ISIS leadership with endorsing the use of chemical weapons. The closest observance of leadership endorsement is from the ISIS spokesperson in January 2020.<sup>123</sup>

According to press reporting on this topic, he stated:

---

<sup>118</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 13.

<sup>119</sup> Ibid. Pg. 15.

<sup>120</sup> Strack, Columb. "The Evolution of the Islamic State’s Chemical Weapons Efforts – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified January 12, 2018. <https://www.ctc.usma.edu/the-evolution-of-the-islamic-states-chemical-weapons-efforts/>.

<sup>121</sup> Ibid.

<sup>122</sup> Ibid.

<sup>123</sup> JERUSALEM POST STAFF. "ISIS Calls on Operatives to Target Jews with Chemical Weapons." The Jerusalem Post | JPost.com. Last modified January 28, 2020. <https://www.jpost.com/breaking-news/isis-we-need-to-conquer-israeli-settlements-start-targeting-jews-615535>.

“O soldiers of the caliphate everywhere below you are the settlements and markets of the Jews. So, make them a testing ground for your weapons: our chemical-bearing rockets.”<sup>124</sup>

### **Data Acquisition: An Ability to Change Approaches to Technology**

As previously stated, “an ability to change approaches to technology” is defined as “knowledge applied for a practical purpose in order to affect and control the user’s environment”<sup>125</sup> and often involves “material objects, as well as systems, processes and techniques, but is always purposive.”<sup>126</sup>

For Aum Shinrikyo, despite having a number of technically competent individuals, not all of the projects were practical nor purposive. Furthermore, the systems and processes in place for the group would result in the eventual dissolution of the organization. Namely, many of the cult’s leaders and associates were arrested following the attack on the Tokyo subway,<sup>127</sup> with no contingency planning, processes, or techniques to follow through on. To the point of impracticality, according to the Centers for a New American Security:

“Projects included creating an astral teleporter (an electronic device to clean one’s “astral dimension”) and the “Perfect Salvation Initiation” headgear (designed to transmit Asahara’s brainwaves to his disciples and replace their own impure brain waves) ... They talked about futuristic technologies of destruction, such as plasma weapons that could atomize human bodies, mirrors several miles across that would float in space reflecting the sun’s rays so that

---

<sup>124</sup> Warrick, Joby. "How the Pentagon Got Inside ISIS' Chemical Weapons Operation—and Ended It." POLITICO. Last modified February 27, 2021. <https://www.politico.com/news/magazine/2021/02/27/red-line-book-excerpt-chemical-weapons-syria-471784>.

<sup>125</sup> Gary A. Ackerman, "'More Bang for the Buck': Examining the Determinants of Terrorist Adoption of New Weapons Technologies" (Ph.D. Dissertation: King's College London, 2014), pp. 19.

<sup>126</sup> Ibid. Pg. 19.

<sup>127</sup> Fletcher, Holly. "Aum Shinrikyo." Council on Foreign Relations. Last modified November 18, 2005. <https://www.cfr.org/background/aum-shinrikyo>.



they destroyed all life in the process, vast laser guns and other imagined means of destruction.”<sup>128</sup>

In contrast, ISIS’s ability to change approaches to technology appears to be one built on contingency planning and practicality. This can be exemplified in their agent of choice: sulfur mustard. Given the group had seized territory; it can be argued that the selection of sulfur mustard was used in a capacity to deny troop advancement and to maintain an area of control.<sup>129</sup>

Evidence of employing sulfur mustard as an area denial weapon was made apparent during World War I with Germany’s use of the agent against the Allies near Ypres, Belgium in July 1917.<sup>130</sup>

Additionally, according to press reporting from ISIS technical experts, measures may have been taken to ensure research data was preserved:

“Moreover, the knowledge and skills acquired from Afari and other veterans of the program undoubtedly still exist, tucked away in computer files, flash drives and in the memories of the surviving participants who scattered as the group’s self-proclaimed caliphate collapsed, Western officials and terrorism experts said.”<sup>131</sup>

Despite the eventual collapse of ISIS’s territory and the dispersal of surviving members, steps had been taken to archive processes and knowledge. Additionally, it is important to note the group has reverted to an insurgency, but now also has the added benefit of having that technical

---

<sup>128</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 20.

<sup>129</sup> Skinner, Harold. "Shell | International Encyclopedia of the First World War (WW1)." 1914-1918-Online. International Encyclopedia of the First World War (WW1). Accessed June 17, 2021. <https://encyclopedia.1914-1918-online.net/article/shell>.

<sup>130</sup> "Sulfur\_mustard." Chemeurope.com - The Chemistry Information Portal from Laboratory to Process. Accessed July 5, 2021. [https://www.chemeurope.com/en/encyclopedia/Sulfur\\_mustard.html](https://www.chemeurope.com/en/encyclopedia/Sulfur_mustard.html).

<sup>131</sup> Warrick, Joby. "Exclusive: Iraqi scientist says he helped ISIS make chemical weapons." The Washington Post. Last modified January 21, 2019. [https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd\\_story.html?noredirect=on](https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd_story.html?noredirect=on).

knowledge at their disposal. Shiraz Maher identifies that “this is a group that emerged from being an insurgency into a proto-state, and it’s now simply pulling back to what it knows best.”<sup>132</sup>

Most importantly, ISIS took measures to continue chemical weapon initiatives by not only reducing the level of tacit knowledge required but also being able to transmit that information to its global enterprise. This was exemplified in a 2017 Australian ISIS bomb plot whereby a secondary plot revealed plans of a toxic gas attack against public transit.<sup>133</sup> The toxic gas was identified to be hydrogen sulfide, an inherently easy toxic gas to produce with far less precursor materials required when compared to sulfur mustard.<sup>134</sup> Despite ISIS’s territorial degradation by 2017, Iraq and Syria-based ISIS attack plotters (Tarek Khayat and Basil Hassan) essentially were able to directly support the Australia-based ISIS members (Khaled Khayat and Mahmoud Khayat) by providing technical support via encrypted communication platforms, such as Telegram.<sup>135</sup> According to Andrew Zammit, at the Combating Terrorism Center at West Point:

“Although the plotters’ priority was to prepare the bomb to destroy an international airliner, they worked on multiple attack plans at the same time, demonstrating the plot’s ambitions. The second plan was the chemical weapon attack. On May 6, 2017, Khaled was sent instructions on how to create a chemical compound that could be dispersed as a lethal gas...Khaled began by gathering the precursor chemicals and again kept Tarek Khayat and Basil Hassan updated on his progress by sending photos. On May 21, 2017, either

---

<sup>132</sup> Smith, Saphora. "Down but Not Out: Why ISIS Will Still Be a Threat in 2018." NBC News. Last modified December 27, 2017. <https://www.nbcnews.com/storyline/isis-terror/isis-will-remain-threat-2018-experts-warn-n828146>.

<sup>133</sup> McKirdy, Euan, and Karen Smith. "Foiled Plot to Blow Up Plane, Unleash Gas Revealed in Australia." CNN. Last modified August 5, 2017. <https://www.cnn.com/2017/08/03/asia/australia-plane-terror-plot-isis/index.html>.

<sup>134</sup> Ibid.

<sup>135</sup> Zammit, Andrew. "Operation Silves: Inside the 2017 Islamic State Sydney Plane Plot – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified April 29, 2020. <https://ctc.usma.edu/operation-silves-inside-the-2017-islamic-state-sydney-plane-plot/>.

Tarek or Hassan via Telegram sent Khaled a video showing how to turn the chemical compound, which they had not yet created, into a poisonous gas.”<sup>136</sup>

It is unlikely the Australia-based ISIS members could have come up with this conventional and unconventional attack plot as Zammit’s report credits these innovative approaches to Basil Hassan and Tarek Khayat.<sup>137</sup>

## **Discussion**

Having provided a holistic account of the chemical weapon factors associated with Aum Shinrikyo and ISIS, an important initial discussion point is to address how these circumstances align with one of Forest’s rare instances where VNSAs had low practical and strategic constraints.<sup>138</sup> As previously identified practical constraint theory can be broken down into technical and environmental considerations, and include the following factors: technical expertise, safe haven, funding, access to production facilities, and an ability to change approaches to technology.<sup>139</sup> Strategic constraint theory, considers the VNSA WMD factor associated with leadership endorsement. Referring back to Figure 1, let’s consider how our VNSA chemical weapon efforts align with weapon complexity and the likelihood of success. In this case, sarin would align with the upper left portion of this model whereas sulfur mustard, chlorine, and hydrogen sulfide weaponization pursuits would align with the middle to lower right portions of the model.

---

<sup>136</sup> Zammit, Andrew. "Operation Silves: Inside the 2017 Islamic State Sydney Plane Plot – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified April 29, 2020. <https://ctc.usma.edu/operation-silves-inside-the-2017-islamic-state-sydney-plane-plot/>.

<sup>137</sup> Ibid.

<sup>138</sup> Forest, James J.F. "Framework for Analyzing the Future Threat of WMD Terrorism." *Journal of Strategic Security* 5, no. 4 (2012): 60-61. Accessed June 21, 2021. <https://www.jstor.org/stable/26463973>

<sup>139</sup> Ibid. Pg. 54-55.

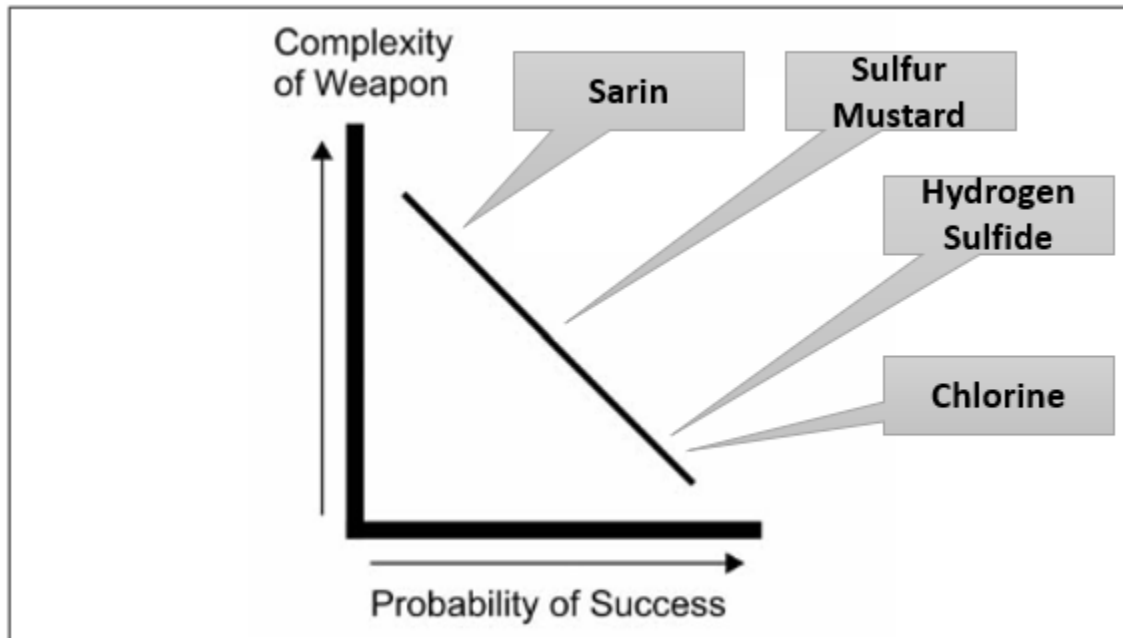


Figure 5: Practical Constraint Model and ISIS/Aum Shinrikyo Agent Pursuits<sup>140</sup>

What can be inferred is that ISIS appeared to have more success relative to Aum Shinrikyo. Although both groups had secured safe haven, recruited technical experts, amassed funding, constructed production facilities, and received leadership endorsement, where these groups deviated was in their ability to change approaches to technology.

Safe haven for both Aum Shinrikyo and ISIS served as integral launching points to obtain operational flexibility, albeit in different ways. Aum Shinrikyo's approach of effectively circumventing state governance and law enforcement by using legislative proceedings to identify as a religious body allowed the group to ascertain significant land holdings that would not be privy to local security forces.<sup>141</sup> Conversely, ISIS would forcibly seize territory and for a time

<sup>140</sup> Forest, James J.F. "Framework for Analyzing the Future Threat of WMD Terrorism." *Journal of Strategic Security* 5, no. 4 (2012): 55. Accessed June 21, 2021. <https://www.jstor.org/stable/26463973>

<sup>141</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, "Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons," *Centers for a New American Security*, July 2011: Pg. 13.

would become the authority in that region, allowing them to operate permissibly.<sup>142</sup> If a VNSA does not have a permissible operating space or safe haven then their activities are effectively limited, to include chemical weaponization efforts. The reason why a territorial hold is important is that it allows a VNSA to act with impunity, with the secondary benefit of having immediate access to potential chemical weapons or chemical weapon precursors. According to Geoffrey Chapman, while exploring chemical weapon usage patterns associated with Salafi-Jihadist groups:

“As both Al-Nusra and IS [Islamic State of Iraq and Syria] have had control over territory they are free to operate with relative impunity compared to a cell-based terrorist group in a hostile state. Control over territory has also meant easy access to chlorine which is used ubiquitously for sanitation. In December 2012, Al-Nusra captured the SYSACCO plant near Aleppo and reportedly removed 200 tonnes of chlorine. Similarly, IS allegedly appropriated chlorine from water treatment facilities in territory it held.”<sup>143</sup>

A secondary effect in securing safe haven for both ISIS and Aum Shinrikyo was a natural tendency for both groups to gravitate toward a bureaucratic or hierarchical structure. Akin to a state, once Aum Shinrikyo and ISIS acquired safe haven there appears to have been a tendency for both VNSAs to structure themselves in such a way to effectively “govern” these spaces. Aum Shinrikyo for instance was organized under various ministries (commerce, construction, defense, finance, education, etc.)<sup>144</sup> while ISIS was similarly bureaucratic. According to Stanford’s Center for International Security and Cooperation:

---

<sup>142</sup> "MMP: Islamic State." FSI | CISAC - CISAC. Accessed June 15, 2021.

[https://cisac.fsi.stanford.edu/mappingmilitants/profiles/islamic-state#highlight\\_text\\_12400](https://cisac.fsi.stanford.edu/mappingmilitants/profiles/islamic-state#highlight_text_12400).

<sup>143</sup> Chapman, Geoffrey. "Islamic State and Al-Nusra: Exploring Determinants of Chemical Weapons Usage Patterns." *Perspectives on Terrorism* 11, no. 6 (2017): 112-21. Accessed June 21, 2021.

<http://www.jstor.org/stable/26295960>

<sup>144</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” *Centers for a New American Security*, July 2011: Pg. 12.

“As IS [ISIS] accumulated more territory, the creation of a bureaucracy and establishment of a functioning state became a central goal of the organization.

IS created a complex taxation system to fund government programs and military campaigns, and the group used the threat of violence to ensure these state services functioned efficiently.”<sup>145</sup>

VNSAs organized under this type of system function much more efficiently. David Tucker highlights VNSA organizational efficiencies attributed to hierarchical constructs but also provides the caveat that bureaucracies tend to slow down the decision-making process:

“Hierarchies, or more exactly organizations with centralized control, provide accountability and can enforce standards. They also can implement decisions more quickly and efficiently than networks, or organizations without centralized control, but they may make those decisions more slowly than the speed at which their environment is changing, since information must travel through many layers to get to decision makers.”<sup>146</sup>

An additional noteworthy effect was the correlation between an influx of personnel and establishing safe haven. For Aum Shinrikyo as more individuals joined the group, this necessitated expanding “communal facilities.”<sup>147</sup> For ISIS, the group would seize large swaths of territory, which would largely inspire individuals to migrate in support of the “established caliphate.”<sup>148</sup> In either instance, safe haven seems to promote a flow of personnel, some of which probably included technical experts responsible for both respective VNSA chemical weapon efforts.

---

<sup>145</sup> "MMP: Islamic State." FSI | CISAC - CISAC. Accessed June 15, 2021.

[https://cisac.fsi.stanford.edu/mappingmilitants/profiles/islamic-state#highlight\\_text\\_12400](https://cisac.fsi.stanford.edu/mappingmilitants/profiles/islamic-state#highlight_text_12400).

<sup>146</sup> Tucker, David. “Terrorism, Networks, and Strategy: Why the Conventional Wisdom is Wrong.” *Homeland Security Affairs* 4, Article 5 (June 2008). <https://www.hsaj.org/articles/122>

<sup>147</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” *Centers for a New American Security*, July 2011: Pg. 17.

<sup>148</sup> "MMP: Islamic State." FSI | CISAC - CISAC. Accessed June 15, 2021.

[https://cisac.fsi.stanford.edu/mappingmilitants/profiles/islamic-state#highlight\\_text\\_12400](https://cisac.fsi.stanford.edu/mappingmilitants/profiles/islamic-state#highlight_text_12400).

<b>Factors</b>	<b>Aum Shinrikyo</b>	<b>ISIS</b>
<b>Possessed Safe Haven</b>	Yes	Yes
<b>Possessed Technical Experts</b>		
<b>Possessed Funding</b>		
<b>Possessed Access to Production Facilities</b>		
<b>Possessed Leadership Enabled Endorsement</b>		
<b>Possessed An Ability to Change Approaches to Technology</b>		

When considering the technical experts associated with Aum Shinrikyo and ISIS, there is little doubt that Masami Tsuchiya and Abu Malik served instrumental roles within their respective organizations and that their technical expertise was a factor that impacted the development and use of chemical weapons by these VNSAs. However, both groups arguably needed the time and space or safe haven in order to achieve their group’s chemical weapon efforts.

Separately, it is of interest that a multitude of efforts were being tested or trialed until a final decision was made with how to allocate resources accordingly. For example, Aum Shinrikyo while having decided to pursue a sarin weaponization project had also tested biological weapons, which ultimately failed.<sup>149</sup> ISIS, while attempting to solidify control of territory, was noted as having used chlorine gas before making a transition to sulfur mustard.<sup>150</sup> These testing or trial periods are important for VNSA chemical weapon efforts and reinforce the time and space or

---

<sup>149</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 24-27.

<sup>150</sup> Warrick, Joby. "How the Pentagon Got Inside ISIS’ Chemical Weapons Operation—and Ended It." POLITICO. Last modified February 27, 2021. <https://www.politico.com/news/magazine/2021/02/27/red-line-book-excerpt-chemical-weapons-syria-471784>.

safe haven argument; essentially highlighting a need for experts to see what works and what does not. This can be further exemplified in another publication from Joby Warrick, where ISIS conducted chemical weapon experiments on Iraqi prisoners after having seized territory:

“The previously unknown experiments happened sometime after 2014, when the Islamic State seized control of Mosul and commandeered the city’s main university as a research center for new kinds of weapons, according to the report by a panel appointed by the U.N. Security Council to investigate war crimes by the extremist group. At least some of the prisoners died, the report said. The investigators examined reports of prisoners being exposed to thallium, a highly toxic chemical used historically as a rat poison, as well as nicotine, which is lethal in high doses. U.N. officials also are exploring the Islamic State’s efforts to weaponize chlorine and manufacture sulfur mustard, the chemical weapon commonly known as mustard gas that was used to kill and maim thousands of soldiers in World War I.”<sup>151</sup>

An additional discussion point in terms of technical expertise is the divergence amongst the groups in terms of the tacit knowledge barriers and agents of choice. As previously identified, tacit knowledge is somewhat more elusive as it tends to rely on “hands on” understanding in a relevant field, making it harder to codify and difficult to transfer.<sup>152</sup> With Aum Shinrikyo, Masami Tsuchiya was heavily relied upon for his knowledge and highlights instances whereby others without his skill set hampered production efforts:

“Tsuchiya felt that the plant was well run under Takizawa but operations were handicapped by the principals’ limited knowledge of chemistry. Errors occurred. A leading example, according to Tsuchiya, was that in February and March 1994 Nakagawa added too much isopropyl alcohol during the difficult fifth and final step of the synthetic process.”<sup>153</sup>

---

<sup>151</sup> Warrick, Joby. "ISIS used chemical weapons on Iraqi prisoners, U.N. investigators find." The Washington Post. Last modified May 13, 2021. [https://www.washingtonpost.com/national-security/isis-chemical-weapons-experiments-mosul/2021/05/13/bbfebf0-b42e-11eb-a980-a60af976ed44\\_story.html](https://www.washingtonpost.com/national-security/isis-chemical-weapons-experiments-mosul/2021/05/13/bbfebf0-b42e-11eb-a980-a60af976ed44_story.html).

<sup>152</sup> Jackson, Brian A., Technology Acquisition by Terrorist Groups: Threat Assessment Informed by Lessons from Private Sector Technology Adoption. Santa Monica, CA: RAND Corporation, 2001. <https://www.rand.org/pubs/reprints/RP1248.html>. Pg. 8-9.

<sup>153</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 29.



Conversely, even after Abu Malik was killed in 2015, ISIS was still able to produce sulfur mustard.<sup>154</sup> The following graphic, sourced from West Point’s Counter Terrorism Center, details ISIS’s chemical weapon use between 2014 to 2017:<sup>155</sup>

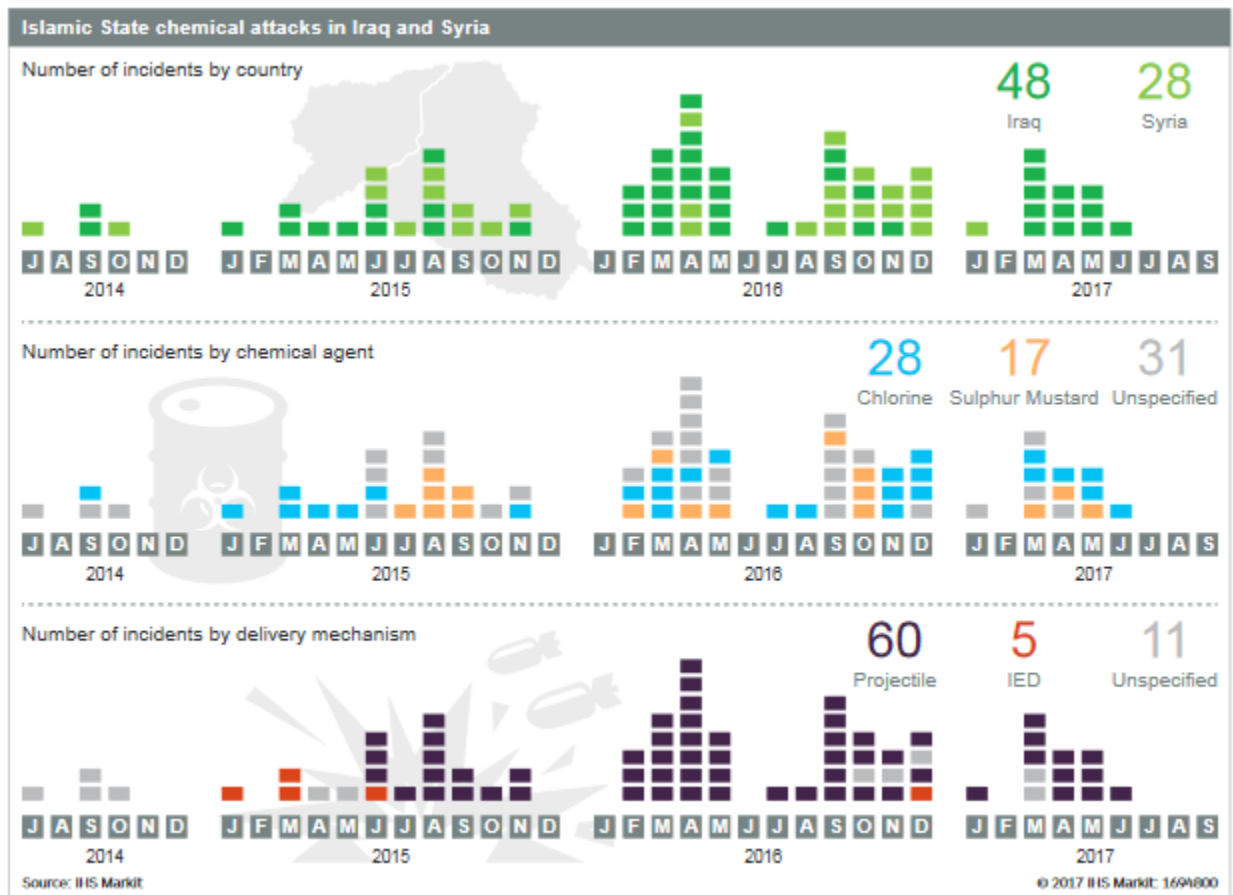


Figure 6: ISIS Chemical Weapon Attacks in Iraq and Syria<sup>156</sup>

What this suggests is that tacit knowledge and agent choice are linked, i.e., sarin is more technically complex requiring more tacit knowledge, whereas sulfur mustard is less technically complex requiring less tacit knowledge. The implication of this is that VNSAs, if inclined may

<sup>154</sup> Strack, Columb. "The Evolution of the Islamic State’s Chemical Weapons Efforts – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified January 12, 2018. <https://www.ctc.usma.edu/the-evolution-of-the-islamic-states-chemical-weapons-efforts/>.

<sup>155</sup> Ibid.

<sup>156</sup> Ibid.

pursue chemical weapon efforts that are technically easier, requiring less tacit knowledge and understanding.

<b>Factors</b>	<b>Aum Shinrikyo</b>	<b>ISIS</b>
<b>Possessed Safe Haven</b>	Yes	Yes
<b>Possessed Technical Experts</b>	Yes	Yes
<b>Possessed Funding</b>		
<b>Possessed Access to Production Facilities</b>		
<b>Possessed Leadership Enabled Endorsement</b>		
<b>Possessed An Ability to Change Approaches to Technology</b>		

Although data is not available for providing specific financial breakdowns for ISIS or Aum Shinrikyo’s chemical weapon efforts, several key items can be inferred. Broadly speaking, when both organizations reached their peak, they had a significant ability to accrue funding. Furthermore, a peak in funding also aligned very much with a realized chemical weapon effort. This suggests that funding provides VNSAs with operational flexibility to pursue special projects such as chemical weapon efforts. However, an important caveat is that financing chemical weapon efforts takes into account purchasing equipment or unique precursor chemicals for manufacturing or production pathways. Outside of purchasing these items, some VNSAs may steal or repurpose industrial chemicals, which is not capital intensive. Unstable states or regions where the VNSA is empowered to operate permissibly, could also take advantage of a state’s inability to control chemical stockpiles, as Ackerman states:

“In the event that a VNSA pursues a ready-made chemical weapon, it might do so through theft...unstable states might also lose control of these weapons, as has been reported in the case of Syria and Iraq, where the Islamic State of Iraq

and the Levant (ISIL) allegedly gained access to weapons stockpiles of the Syrian and former Iraqi regimes.”<sup>157</sup>

ISIS and Aum Shinrikyo both derived the vast majority of their funding from established safe havens, which reinforces the importance of these permissible operating spaces. What’s more, financing would allow these groups to build up chemical weapon capabilities within their own operating areas. When Aum Shinrikyo decided to move from small scale to production-scale sarin efforts, the group would do so at a location identified as Satyan 7.<sup>158</sup> Satyan 7 under the guise of an Aum Shinrikyo shrine was in reality a large-scale chemical weapon production facility with legitimately purchased top-of-the-line equipment.<sup>159</sup> According to a United Nations report, the compound and its contents cost approximately \$30 million.<sup>160</sup>

<b>Factors</b>	<b>Aum Shinrikyo</b>	<b>ISIS</b>
<b>Possessed Safe Haven</b>	Yes	Yes
<b>Possessed Technical Experts</b>	Yes	Yes
<b>Possessed Funding</b>	Yes	Yes
<b>Possessed Access to Production Facilities</b>		
<b>Possessed Leadership Enabled Endorsement</b>		
<b>Possessed An Ability to Change Approaches to Technology</b>		

Production facilities, like funding and the recruitment of technical experts, are arguably tied to the safe haven nexus with these facilities being physically located within a VNSA’s territorial

<sup>157</sup> Ackerman, Gary, and Michelle Jacome. "WMD Terrorism: The Once and Future Threat." PRISM, Countering Weapons of Mass Destruction 7, no. 3 (2018), 22-36. <https://www.jstor.org/stable/10.2307/26470532>. Pg. 26.

<sup>158</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, "Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons," Centers for a New American Security, July 2011: Pg. 28.

<sup>159</sup> Olson, Kyle B. "Aum Shinrikyo: Once and Future Threat?" Emerging Infectious Diseases 5, no. 4 (1999), 413-416. doi:10.3201/eid0504.990409.

<sup>160</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, "Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons," Centers for a New American Security, July 2011: Pg. 28.

control or permissible operating environment. Furthermore, production facilities also play a determining factor as they relate to the effectiveness of a chemical weapon effort. For example, production facilities producing large quantities of an agent may vary wildly in yield, purity, or virulence. ISIS was able to probably produce large quantities of sulfur mustard but statements released indicated the following:

“Explosions had released ‘a yellow gas with a strong smell of onions,’ and that ‘the ground immediately around the impact sites was stained with an olive-green liquid that turned to a golden yellow after exposure to sunshine.’”<sup>161</sup>

Based on this description and supported in other press reporting,<sup>162</sup> ISIS’s sulfur mustard was impure, suggesting flaws either in the production process or mistakes inherent to the methodological approach the group was using to produce this agent. According to the U.S. National Center for Biotechnology Information, when sulfur mustard is in its purest form it is odorless and colorless and when low grade chemical additives are introduced can produce an onion or garlic smell.<sup>163</sup>

Conversely, in 1993, Aum Shinrikyo was able to refine its production processes and achieve a 90 percent purity rate for sarin at bench scale only to have purity plummet when seeking to achieve industrial production.<sup>164</sup> The implication is that VNSAs seriously considering chemical weapon

---

<sup>161</sup> Strack, Columb. "The Evolution of the Islamic State’s Chemical Weapons Efforts – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified January 12, 2018. <https://www.ctc.usma.edu/the-evolution-of-the-islamic-states-chemical-weapons-efforts/>.

<sup>162</sup> Warrick, Joby. "How the Pentagon Got Inside ISIS’ Chemical Weapons Operation—and Ended It." POLITICO. Last modified February 27, 2021. <https://www.politico.com/news/magazine/2021/02/27/red-line-book-excerpt-chemical-weapons-syria-471784>.

<sup>163</sup> PubChem. "Mustard Gas." National Center for Biotechnology Information. Accessed June 23, 2021. <https://pubchem.ncbi.nlm.nih.gov/compound/Mustard-gas>.

<sup>164</sup> Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, “Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons,” Centers for a New American Security, July 2011: Pg. 28-29.

pursuits should understand that large scale or production-grade capacity could be dramatically more difficult than research or bench scale efforts.

<b>Factors</b>	<b>Aum Shinrikyo</b>	<b>ISIS</b>
<b>Possessed Safe Haven</b>	Yes	Yes
<b>Possessed Technical Experts</b>	Yes	Yes
<b>Possessed Funding</b>	Yes	Yes
<b>Possessed Access to Production Facilities</b>	Somewhat	Somewhat
<b>Possessed Leadership Enabled Endorsement</b>		
<b>Possessed An Ability to Change Approaches to Technology</b>		

Leadership endorsement for a VNSA chemical weapon effort stresses the intentions of the group, whereas other factors focus more on capability. The wider consideration for a VNSA chemical weapon effort is that if a group is able to acquire safe haven and all other factors, this does not lead to a chemical weapon pursuit without an intent. The rationale here is a VNSA leader may consider chemical weapon initiatives to be a waste of resources or there may be a fear of harsh reprisal from counterterrorism forces that could threaten the group’s integrity. In effect, leadership endorsement may be an antecedent variable, which “occurs before the independent and dependent variables... and can help explain the relationship between the two.”<sup>165</sup>

<b>Factors</b>	<b>Aum Shinrikyo</b>	<b>ISIS</b>
<b>Possessed Safe Haven</b>	Yes	Yes
<b>Possessed Technical Experts</b>	Yes	Yes
<b>Possessed Funding</b>	Yes	Yes
<b>Possessed Access to Production Facilities</b>	Somewhat	Somewhat
<b>Possessed Leadership Enabled Endorsement</b>	Yes	Somewhat

<sup>165</sup> "What is an Antecedent Variable? (Explanation & Example)." Statology. Last modified September 25, 2020. <https://www.statology.org/antecedent-variable/>.

<b>Possessed An Ability to Change Approaches to Technology</b>		
--	--	--

What is unique about the VNSA factor regarding an ability to change approaches to technology is that it can be a determinant of a group’s survival. If a VNSA is unable to plan for contingencies to change their systems or processes then their initiatives, to include chemical weaponization, can be disrupted. However, if a group is able to adopt new technologies or modify practices to circumvent counterterrorism pressure then they can prosper.

Aum Shinrikyo, failed to plan accordingly and adopt technological practices or systems that would preserve the integrity of the organization. ISIS, however, would implement various changes in their TTPs that ensured their viability, not only as a terrorist organization but allow them to potentially conduct future chemical weapon attacks. The justification for this is the aforementioned ability to archive and potentially disseminate chemical weapon information<sup>166</sup> or the ability to enable attack plots that do not necessitate high degrees of technical expertise and the acquisition of elaborate precursor materials – such as hydrogen sulfide.<sup>167</sup> What’s more is that ISIS has an extensive global network of affiliates that they may exploit to conduct potential chemical weapon attack plots.<sup>168</sup>

<b>Factors</b>	<b>Aum Shinrikyo</b>	<b>ISIS</b>
<b>Possessed Safe Haven</b>	Yes	Yes
<b>Possessed Technical Experts</b>	Yes	Yes

<sup>166</sup> Warrick, Joby. "Exclusive: Iraqi scientist says he helped ISIS make chemical weapons." The Washington Post. Last modified January 21, 2019. [https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd\\_story.html?noredirect=on](https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd_story.html?noredirect=on).

<sup>167</sup> McKirdy, Euan, and Karen Smith. "Foiled Plot to Blow Up Plane, Unleash Gas Revealed in Australia." CNN. Last modified August 5, 2017. <https://www.cnn.com/2017/08/03/asia/australia-plane-terror-plot-isis/index.html>.

<sup>168</sup> Staff, Reuters. "U.S. Says ISIS Evolved to Become a Global Network That Inspires Attacks Worldwide." U.S. Last modified June 24, 2020. <https://www.reuters.com/article/us-usa-security-extremists/u-s-says-isis-evolved-to-become-a-global-network-that-inspires-attacks-worldwide-idUSKBN23V2CT>.

<b>Possessed Funding</b>	Yes	Yes
<b>Possessed Access to Production Facilities</b>	Somewhat	Somewhat
<b>Possessed Leadership Enabled Endorsement</b>	Yes	Somewhat
<b>Possessed An Ability to Change Approaches to Technology</b>	No	Yes

### Comparative Analysis and Findings

Using Aum Shinrikyo as a baseline and having compared this to the more contemporary VNSA group ISIS, we can see what factors impacted the development and use of chemical weapons by these VNSAs. Our hypothesis for this study proved correct in that an increase in available safe haven or an ability to change approaches to technology makes a VNSA chemical weapon effort more likely.

<b>Factors</b>	<b>Aum Shinrikyo</b>	<b>ISIS</b>
<b>Possessed Safe Haven</b>	Yes	Yes
<b>Possessed Technical Experts</b>	Yes	Yes
<b>Possessed Funding</b>	Yes	Yes
<b>Possessed Access to Production Facilities</b>	Somewhat	Somewhat
<b>Possessed Leadership Enabled Endorsement</b>	Yes	Somewhat
<b>Possessed An Ability to Change Approaches to Technology</b>	No	Yes

By examining the chemical weapon factors between these exemplar cases, it was determined, that safe haven was foundational and allowed for the acquisition of technical experts, accumulation of funding, and the establishment of production facilities. Leadership between these organizations informed this study by indicating that it served more as the “intention” associated with a VNSA chemical weapon effort. Finally, an ability to change approaches to

technology was a key factor as it inferred that if a group does not have contingency planning related to a change in systems and approaches or make use of practical technological advancement then there is a tendency for the organization to be disrupted or destroyed.

After having examined these chemical weapon factors with respect to Aum Shinrikyo and ISIS, it's important to revisit the idea that a number of these factors could also apply to conventional weapon pursuits or other innovative engineering projects. As we identified earlier in the paper, the FARC used the jungle as a safe haven to create "Narco-subs" but was not inclined to pursue chemical weapons; the decision of which was likely based on the direction of VNSA leadership.<sup>169</sup> The importance of this example resonates with being able to identify unique indicators for a chemical weapon effort v. other engineering projects. Beyond having insight into VNSA leadership intentions, other indicators of a chemical weapon effort could involve the acquisition of specialized precursor materials. From this perspective, Aum Shinrikyo developed the nerve agent sarin, a principle precursor of which is O-Isopropyl methylphosphonofluoridate.<sup>170</sup> Separately, ISIS developed sulfur mustard, and some of the key precursors include 2-Chloroethylchloromethylsulfide and Bis(2-chloroethyl)sulfide.<sup>171</sup> Essentially, these are chemical weapon precursors unique to these efforts and would not be applicable toward explosive production routes. Figure 7 and 8 provide additional context in terms of the chemical composition of the nerve and blister agents under consideration:

---

<sup>169</sup> Gary A. Ackerman, "'More Bang for the Buck': Examining the Determinants of Terrorist Adoption of New Weapons Technologies" (Ph.D. Dissertation: King's College London, 2014), pp. 32.

<sup>170</sup> "Schedule 1." OPCW. Accessed July 27, 2021. <https://www.opcw.org/chemical-weapons-convention/annexes/annex-chemicals/schedule-1>.

<sup>171</sup> Ibid.



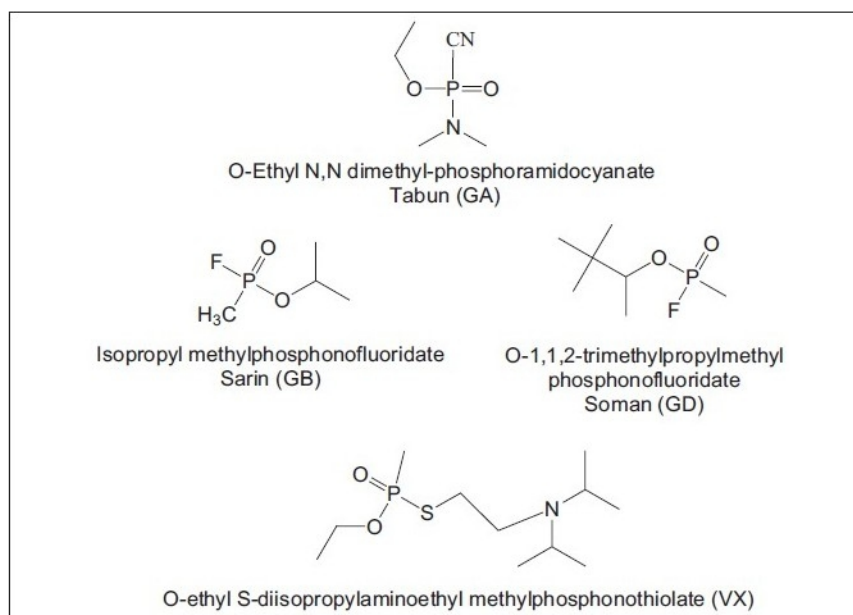


Figure 7: Chemical Structure of Nerve Agents<sup>172</sup>

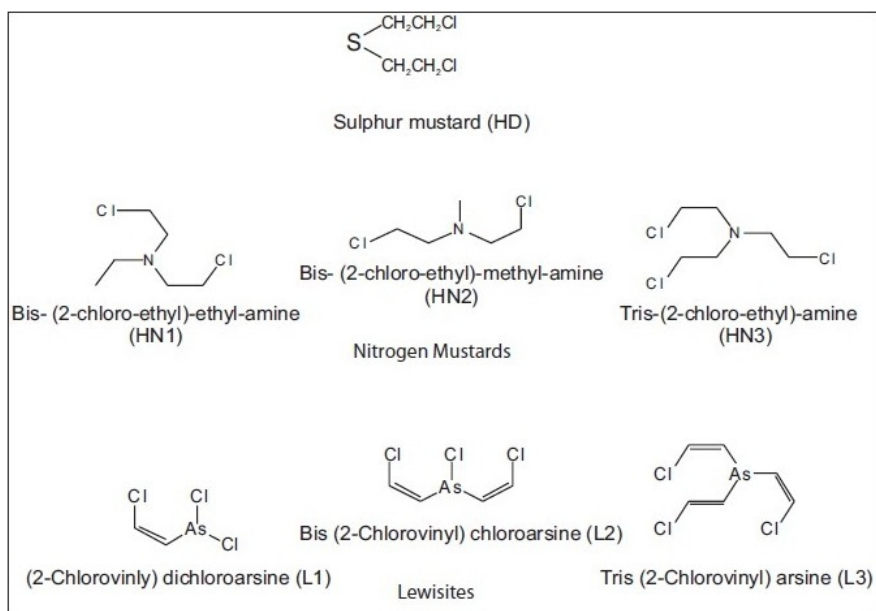


Figure 8: Chemical Structure of Blister Agents<sup>173</sup>

<sup>172</sup> Ganesan K, Raza SK, Vijayaraghavan R. Chemical warfare agents. *J Pharm Bioallied Sci.* 2010;2(3):166-178. doi:10.4103/0975-7406.68498

<sup>173</sup> Ibid.

Conversely, if a VNSA were considering a conventional weapon pursuit or explosive weapon effort, they would likely seek several of the following precursors: acetone, aluminum powder, ammonium nitrate, hydrogen peroxide, nitric acid, glycerin, and potassium permanganate.<sup>174</sup>

These precursors differ significantly from the chemical precursors required for a sarin and sulfur mustard effort. As such, identifying these unique indicators may provide the timely warning needed in order to counter a VNSA chemical weapon effort.

When separately examining safe haven and an ability to change approaches to technology, the latter of these two factors might actually end up being more important than the former. For example, if a VNSA decides to pursue a chemical weapon effort whereby there is a technology or strategy that “de-skills” the effort or the agent of choice is not dependent on safe haven then a VNSA could be placed in an advantaged position. As such, technical expertise might not be needed to deploy a simplistic chemical weapon – for example, using a drone to deliver a simplistic toxic gas (hydrogen sulfide, hydrogen cyanide, chlorine, etc.). Furthermore, if safe haven is no longer a requisite and the chemical agent is simplistic then the VNSA can allocate more assets to develop an optimal delivery platform, instead of investing an inordinate amount of time perfecting a chemical agent that could be overly complex. Scholars and national security personnel alike have considered innovative scenarios whereby VNSAs could potentially use drone technologies in combination with WMD materials.<sup>175</sup>

---

<sup>174</sup> "Chemical and Explosives Terrorism." INTERPOL | The International Criminal Police Organization. Accessed July 26, 2021. <https://www.interpol.int/en/Crimes/Terrorism/Chemical-and-Explosives-terrorism>.

<sup>175</sup> Daniels, Jeff. "Terrorists Have a Cheap New Weapon That's Surprisingly Simple to Deploy." CNBC. Accessed July 5, 2021. <https://www.cnbc.com/2016/10/24/terrorists-have-a-cheap-new-weapon-thats-surprisingly-simple-to-deploy.html>.

As far back as 1999, Abu Mus'ab al Zarqawi displayed an interest in unconventional or chemical weapons.<sup>176</sup> By 2014, ISIS began using drones to gather battlefield intelligence and shortly thereafter the group would weaponize these same platforms to drop explosive munitions.<sup>177</sup>

Although we have yet to see a chemical weapon drone platform used by ISIS, the concern is that ISIS continues to maintain a chemical weapon interest – as voiced by the ISIS spokesman just last year<sup>178</sup> – and has also displayed a proficiency for drone use in a battlefield context. Beyond maintaining an interest in chemical weapons, the group also commands an ability to not only archive<sup>179</sup> chemical weapon data but also transmit this information to ISIS members worldwide.

<sup>180</sup> Koblentz, effectively conveys the increasing threats faced by security officials with the potential marriage of drone technologies and WMD, as followed:

“Finally, UAVs could one day be used to deliver a weapon of mass destruction. Nuclear weapons will remain too large and heavy for delivery by the type of UAV that a non-state actor could build or buy, but other types of CBRN weapons could be delivered by drones. The small-payload, low-speed, and low-altitude flight profile of UAVs make them well suited for delivering chemical and biological agents against civilian targets. A crop-spraying drone designed for use in the developing world can carry twenty liters of pesticides— or sarin.”<sup>181</sup>

---

<sup>176</sup> Strack, Columb. "The Evolution of the Islamic State's Chemical Weapons Efforts – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified January 12, 2018. <https://www.ctc.usma.edu/the-evolution-of-the-islamic-states-chemical-weapons-efforts/>.

<sup>177</sup> Warrick, Joby. "Use of weaponized drones by ISIS spurs terrorism fears." The Washington Post. Last modified February 21, 2017. [https://www.washingtonpost.com/world/national-security/use-of-weaponized-drones-by-isis-spurs-terrorism-fears/2017/02/21/9d83d51e-f382-11e6-8d72-263470bf0401\\_story.html](https://www.washingtonpost.com/world/national-security/use-of-weaponized-drones-by-isis-spurs-terrorism-fears/2017/02/21/9d83d51e-f382-11e6-8d72-263470bf0401_story.html).

<sup>178</sup> JERUSALEM POST STAFF. "ISIS Calls on Operatives to Target Jews with Chemical Weapons." The Jerusalem Post | JPost.com. Last modified January 28, 2020. <https://www.jpost.com/breaking-news/isis-we-need-to-conquer-israeli-settlements-start-targeting-jews-615535>.

<sup>179</sup> Warrick, Joby. "Exclusive: Iraqi scientist says he helped ISIS make chemical weapons." The Washington Post. Last modified January 21, 2019. [https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd\\_story.html?noredirect=on](https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd_story.html?noredirect=on).

<sup>180</sup> Zammit, Andrew. "Operation Silves: Inside the 2017 Islamic State Sydney Plane Plot – Combating Terrorism Center at West Point." Combating Terrorism Center at West Point. Last modified April 29, 2020. <https://ctc.usma.edu/operation-silves-inside-the-2017-islamic-state-sydney-plane-plot/>.

<sup>181</sup> Koblentz, Gregory D. "Emerging Technologies and the Future of CBRN Terrorism." The Washington Quarterly 43, no. 2 (2020), 177-196. doi:10.1080/0163660x.2020.1770969. Pg. 180.

## Limitations and Future Research

When considering the limitations associated with this research study, more data points or additional VNSA groups could have been considered as part of the comparative analysis. This expansion of the number of VNSAs could have included groups that considered but failed to achieve a chemical weapon effort. Additionally, it may have also proved beneficial as a supplementary data point to examine a VNSA that did not pursue chemical weapon efforts, but could seemingly have the capability. An example of a group that has robust capabilities but does not have a discernable chemical weapon effort is Lashkar-e-Taiba (LeT), according to the Carnegie Endowment for International Peace:

“LeT operates a robust above-ground infrastructure that, combined with investments in legitimate enterprises in Pakistan and fundraising networks abroad, has enabled it to operate independent of direct ISI financial support. While it continues to enjoy reach-back capability into the Pakistani military and ISI, LeT also has leveraged its financial resources and operational freedom to develop an educated cadre among its membership. Collectively, these individuals amplify technical, training, and planning capabilities.”<sup>182</sup>

With this in mind, future research could be conducted against VNSAs who have yet to explicitly pursue chemical weapon efforts. This research could involve examining these groups against our factors. Essentially, if a group has a potentially robust capability such as LeT, then scholarship could take a proactive stance in addressing the chemical weapon threat prior to it being realized. An approach could also be taken to examine multiple VNSAs under Forest’s practical and strategic constraint theories, whereby the scholarship could categorically assign VNSAs a chemical weapon threat level (such as low, moderate, or high).<sup>183</sup>

---

<sup>182</sup> Tankel, Stephen. "Lashkar-e-Taiba Capable of Threatening U.S. Homeland." Carnegie Endowment for International Peace. Last modified June 12, 2013. <https://carnegieendowment.org/2013/06/12/lashkar-e-taiba-capable-of-threatening-u.s.-homeland-pub-52081>.

<sup>183</sup> Forest, James J.F. "Framework for Analyzing the Future Threat of WMD Terrorism." *Journal of Strategic Security* 5, no. 4 (2012): 51-68. Accessed June 21, 2021. <https://www.jstor.org/stable/26463973>

## Conclusion

Having examined and assessed the factors associated with a historic and contemporary VNSA's chemical weapon effort and determined that an increase in available safe haven or an ability to change approaches to technology makes a VNSA chemical weapon effort more likely, there are several recommendations to consider. First, states should continue to monitor for key indicators specific to VNSA chemical weapon efforts. These may be differentiated from conventional weapon efforts by looking for a combination of procurement and recruitment initiatives that would align with a chemical weapon end state. Examples of these indicators could be VNSAs purchasing specialized precursor materials, explicitly expressing chemical weapon intentions, and the recruitment of experienced chemists. Mary Zalesny takes this one-step further by providing additional indicators, while also providing the caveat that some of these observables may not be obvious:

“Direct observation of group actions suggestive of interest or intent to use CBW may be difficult. However, other evidence indicative of intent may be available. Technical manuals related to chemical and biological agents, equipment to manufacture chemical or biological agents, or receipts for the purchase of agents or equipment found at a group's current or previous location all reflect at least an interest in chemical or biological agents. The arrest of a group member in possession of such materials, a group's association, partnership with suppliers or users of chemical- or biological-related materials, or third-party observations or statements would also constitute evidence of interest or intent.”<sup>184</sup>

Next, states should continue to deprive ISIS of safe haven. The denial of these permissible operating environments not only inhibit the ability for ISIS to train, recruit, and incur revenue but the lack of safe haven also disrupts ISIS from pursuing chemical weapon or other unconventional efforts. However, as national security priorities shift and the U.S. withdraws

---

<sup>184</sup> Zalesny, Mary, Paul Whitney, and Amanda White. "A Conceptual Model to Identify Intent to Use Chemical-Biological Weapons." *Journal of Strategic Security* 10, no. 3 (2017), 54-86. doi:10.5038/1944-0472.10.3.1612.

from nations like Afghanistan this could give ISIS an opportunity to expand and take these operating spaces. According to a press release on this matter:

“Seth Jones, a senior vice president at the Center for Strategic and International Studies in Washington, D.C., raised concerns about chaos following a post-withdrawal from Afghanistan that ISIS might take the opportunity to seize, saying the issue is that ISIS ‘will be able to find additional space to operate.’”<sup>185</sup>

As priorities shift, accommodative measures should be taken by states to ensure nations like Afghanistan have the necessary financial and governance support to combat VNSA resurgence within these regions.

Additionally, states should seek to maintain competitive advantages in emerging technologies that could be used to enable chemical weapon efforts. This means understanding the potential for ISIS to abuse emerging technologies such as drones. To a certain extent counter-drone technologies have been developed to disrupt drone flight. These technologies are a combination of detection platforms and instruments that destroy or disable the drone. According to a private consulting firm on the matter:

“The technology depends on a variety of techniques for detecting or intercepting drones. Mostly drones are spotted using techniques like Radio Frequency (RF) detection, Electro-Optical and Infrared and are then destroyed with techniques like RF Jamming, GNSS Jamming, Spoofing, Laser, nets, projectile or Combined Interdiction Elements.”<sup>186</sup>

It is important to note that states that seek to develop these types of countermeasures are compelled, at often-great expense, to develop these technologies that are reactive instead of

---

<sup>185</sup> Marnin, Julia. "U.S. Withdrawal from Afghanistan May Give ISIS 'space to Operate,' Expert Says." Newsweek. Last modified April 27, 2021. <https://www.newsweek.com/us-withdrawal-afghanistan-may-give-isis-space-operate-expert-says-1586854>.

<sup>186</sup> Choudhary, Mahashreveta. "Top Five Counter-drone Technologies." Geospatial World. Last modified July 12, 2019. <https://www.geospatialworld.net/blogs/top-five-counter-drone-technologies/>.

proactive. An organization like ISIS being much more agile has the potential to adopt other emerging technology that has yet to have a countermeasure. As such, states should be imaginative in their approach and stay ahead of potential emerging technology concerns.

Another recourse for an ISIS chemical weapon effort that states should be aware of is the potential for attack plots similar to the Australia plot conducted in 2017<sup>187</sup> whereby a group could opt for simplistic toxic gas forming reactions such as hydrogen sulfide, which require precursor materials that are readily available. This presents the most difficult concern for state security forces as precursor materials that are widely available are often dual use and often do not raise concern during their acquisition. As such, state resources should be allocated accordingly to law enforcement and intelligence organizations, in order take preventative action against VNSAs seeking to conduct simplistic toxic gas attacks. Additionally, Koblentz provides the following insight as to how the international community can continue to respond to this concern:

“Given the high degree of dual-use, diffusion, and decentralization associated with these emerging technologies, preventing non-state actors from acquiring and using them to cause harm will require international cooperation... One of the international community’s most important tools for preventing nonstate actors from acquiring CBRN weapons is Resolution 1540, approved by the UN Security Council in 2004. Resolution 1540 requires member states to strengthen border security, physical protection, domestic controls, and export controls to prevent non-state actors from acquiring these weapons and related materials.”<sup>188</sup>

---

<sup>187</sup> McKirdy, Euan, and Karen Smith. "Foiled Plot to Blow Up Plane, Unleash Gas Revealed in Australia." CNN. Last modified August 5, 2017. <https://www.cnn.com/2017/08/03/asia/australia-plane-terror-plot-isis/index.html>.

<sup>188</sup> Koblentz, Gregory D. "Emerging Technologies and the Future of CBRN Terrorism." *The Washington Quarterly* 43, no. 2 (2020), 177-196. doi:10.1080/0163660x.2020.1770969. Pg. 188.

## Bibliography

"Aum Shinrikyo (Aleph)." The Mackenzie Institute. Accessed June 16, 2021. <https://mackenzieinstitute.com/2015/12/aum-shinrikyo-aleph/>.

"Country Reports on Terrorism 2019." United States Department of State. Last modified June 24, 2020. <https://www.state.gov/reports/country-reports-on-terrorism-2019/>.

"Chemical and Explosives Terrorism." INTERPOL | The International Criminal Police Organization. Accessed July 26, 2021. <https://www.interpol.int/en/Crimes/Terrorism/Chemical-and-Explosives-terrorism>.

"Federation of American Scientists :: Chemical Weapons Production and Storage." Federation Of American Scientists – Science for a Safer, More Informed World. Last modified September 9, 2013. <https://fas.org/programs/bio/chemweapons/production.html>.

"ISIS Chemical Weapons Expert ‘killed’ in Airstrike." Al Arabiya English. Last modified May 20, 2020. <https://english.alarabiya.net/News/middle-east/2015/01/31/U-S-Coalition-strike-kills-ISIS-chemical-weapons-expert->

"ISIS Chemical Weapon Specialist Was ‘Gathering Equipment’ Before He Was Killed." The Daily Beast. Last modified January 31, 2015. <https://www.thedailybeast.com/isis-chemical-weapon-specialist-was-gathering-equipment-before-he-was-killed>.

"Millennialism | Definition, History, & Facts." Encyclopedia Britannica. Accessed June 6, 2021. <https://www.britannica.com/topic/millennialism>.

"MMP: Islamic State." FSI | CISAC - CISAC. Accessed June 15, 2021. [https://cisac.fsi.stanford.edu/mappingmilitants/profiles/islamic-state#highlight\\_text\\_12400](https://cisac.fsi.stanford.edu/mappingmilitants/profiles/islamic-state#highlight_text_12400).

"North Atlantic Assembly AN 255 STC(96) 10 - CHEMICAL AND BIOLOGICAL WEAPONS: THE POOR MAN'S BOMB." Federation of American Scientists. Last modified October 4, 1996. <https://fas.org/irp/threat/an253stc.htm>.

"Schedule 1." OPCW. Accessed July 27, 2021. <https://www.opcw.org/chemical-weapons-convention/annexes/annex-chemicals/schedule-1>.

"Sulfur\_mustard." Chemeurope.com - The Chemistry Information Portal from Laboratory to Process. Accessed July 5, 2021. [https://www.chemeurope.com/en/encyclopedia/Sulfur\\_mustard.html](https://www.chemeurope.com/en/encyclopedia/Sulfur_mustard.html).

"THE TRANSNATIONAL THREAT." Federation Of American Scientists – Science for a Safer, More Informed World. Accessed June 16, 2021. <https://fas.org/irp/threat/prolif97/trans.html>.

"The War Against ‘Islamic State’ in Maps and Charts." BBC News. Last modified March 28, 2018. <https://www.bbc.com/news/world-middle-east-27838034>.

"Timeline: the Rise, Spread, and Fall of the Islamic State." Wilson Center. Accessed July 5, 2021. <https://www.wilsoncenter.org/article/timeline-the-rise-spread-and-fall-the-islamic-state>.



"The use of the Internet for terrorist purposes." United Nations Office on Drugs and Crime. Last modified 2012.

[https://www.unodc.org/documents/frontpage/Use\\_of\\_Internet\\_for\\_Terrorist\\_Purposes.pdf](https://www.unodc.org/documents/frontpage/Use_of_Internet_for_Terrorist_Purposes.pdf).

"What is an Antecedent Variable? (Explanation & Example)." Statology. Last modified September 25, 2020. <https://www.statology.org/antecedent-variable/>.

Ackerman, Gary A. "Anatomizing Chemical and Biological Non-State Adversaries." Calhoun: The NPS Institutional Archive, January 2014, 1-355.

<https://core.ac.uk/download/pdf/36738176.pdf>.

Ackerman, Gary A. "Comparative Analysis of VNSA Complex Engineering Efforts." *Journal of Strategic Security* 9, no. 1 (2016) : 119-133. DOI: <http://dx.doi.org/10.5038/1944-0472.9.1.1511>

Ackerman, Gary A. "'More Bang for the Buck': Examining the Determinants of Terrorist Adoption of New Weapons Technologies" (Ph.D. Dissertation: King's College London, 2014), pp. 19.

Ackerman, Gary, and Jeremy Tamsett. "Islamist Use and Pursuit of CBRN Terrorism." In *Jihadists and Weapons of Mass Destruction*, 339-340. Boca Raton: CRC Press, 2009.

Ackerman, Gary, and Michelle Jacome. "WMD Terrorism: The Once and Future Threat." *PRISM, Countering Weapons of Mass Destruction* 7, no. 3 (2018), 22-36.

<https://www.jstor.org/stable/10.2307/26470532>.

Chapman, Geoffrey. "Islamic State and Al-Nusra: Exploring Determinants of Chemical Weapons Usage Patterns." *Perspectives on Terrorism* 11, no. 6 (2017): 112-21. Accessed June 21, 2021.

Choudhary, Mahashreveta. "Top Five Counter-drone Technologies." *Geospatial World*. Last modified July 12, 2019. <https://www.geospatialworld.net/blogs/top-five-counter-drone-technologies/>.

Cornish, Paul. "The CBRN System: Assessing the Threat of Terrorist Use of Chemical, Biological, Radiological and Nuclear Weapons in the United Kingdom." Chatham House, February 2007, 1-40. <https://ciaotest.cc.columbia.edu/wps/riia/0001540/0001540.pdf>.

Daniels, Jeff. "Terrorists Have a Cheap New Weapon That's Surprisingly Simple to Deploy." *CNBC*. Accessed July 5, 2021. <https://www.cnn.com/2016/10/24/terrorists-have-a-cheap-new-weapon-thats-surprisingly-simple-to-deploy.html>.

Fletcher, Holly. "Aum Shinrikyo." Council on Foreign Relations. Last modified November 18, 2005. <https://www.cfr.org/background/aum-shinrikyo>.

Forest, James J.F. "Framework for Analyzing the Future Threat of WMD Terrorism." *Journal of Strategic Security* 5, no. 4 (2012): 51-68. Accessed June 21, 2021.

<https://www.jstor.org/stable/26463973>

Heibner, Stefan, Peter Neumann, John Holland-McCowan, and Rajan Basra. "Caliphate in Decline: An Estimate of Islamic State's Financial Fortunes." The International Centre for the Study of Radicalisation and Political Violence, 2017, 1-20.

Hummel, Stephen. "Small Groups, Big Weapons: The Nexus of Emerging Technologies and Weapons of Mass Destruction Terrorism." Combating Terrorism Center at West Point. Last modified April 2, 2020. <https://www.ctc.usma.edu/small-groups-big-weapons-the-nexus-of-emerging-technologies-and-weapons-of-mass-destruction-terrorism/>.

Jabbari, Cyrus, and Philipp Bleek. "Honey, I Shrunk the Lab: Emerging Microfluidics Technology and its Implications for Chemical, Biological, and Nuclear Weapons." *Emergence and Convergence*, no. 5 (May 2019), 1-23. <https://wmdcenter.ndu.edu/Portals/97/EC%20research%20paper%20no%205%20-%20Bleek%20and%20Jabbari.pdf>.

Jackson, Brian A., *Technology Acquisition by Terrorist Groups: Threat Assessment Informed by Lessons from Private Sector Technology Adoption*. Santa Monica, CA: RAND Corporation, 2001. <https://www.rand.org/pubs/reprints/RP1248.html>. Pg. 8-9.

Jefferson, Catherine, Filippa Lentzos, and Claire Marris. "Synthetic Biology and Biosecurity: Challenging the 'Myths'." *Frontiers in Public Health* 2 (2014). doi:10.3389/fpubh.2014.00115.

Joscelyn, Thomas. "US Designates ISIS Chemical Weapons Expert from France As Terrorist." *FDD's Long War Journal*. Last modified March 22, 2018. <https://www.longwarjournal.org/archives/2018/03/us-designates-isis-chemical-weapons-expert-from-france-as-terrorist.php>.

JERUSALEM POST STAFF. "ISIS Calls on Operatives to Target Jews with Chemical Weapons." *The Jerusalem Post | JPost.com*. Last modified January 28, 2020. <https://www.jpost.com/breaking-news/isis-we-need-to-conquer-israeli-settlements-start-targeting-jews-615535>.

Koblentz, Gregory D. "Emerging Technologies and the Future of CBRN Terrorism." *The Washington Quarterly* 43, no. 2 (2020), 177-196. doi:10.1080/0163660x.2020.1770969. Pg. 178-184.

Marnin, Julia. "U.S. Withdrawal from Afghanistan May Give ISIS 'space to Operate,' Expert Says." *Newsweek*. Last modified April 27, 2021. <https://www.newsweek.com/us-withdrawal-afghanistan-may-give-isis-space-operate-expert-says-1586854>.

McKirdy, Euan, and Karen Smith. "Foiled Plot to Blow Up Plane, Unleash Gas Revealed in Australia." *CNN*. Last modified August 5, 2017. <https://www.cnn.com/2017/08/03/asia/australia-plane-terror-plot-isis/index.html>.

Mowatt-Larssen, Rolf. "Al Qaeda Weapons of Mass Destruction Threat: Hype or Reality?" *Belfer Center for Science and International Affairs*. Accessed June 17, 2021.

<https://www.belfercenter.org/publication/al-qaeda-weapons-mass-destruction-threat-hype-or-reality>.

Mowatt-Larsen, Rolf. *Islam and the Bomb: Religious Justification For and Against Nuclear Bombs* (Massachusetts: Belfer Center for Science and International Affairs, 2011), Pg. 20.

Olson, Kyle B. "Aum Shinrikyo: Once and Future Threat?" *Emerging Infectious Diseases* 5, no. 4 (1999), 413-416. doi:10.3201/eid0504.990409.

PubChem. "Mustard Gas." National Center for Biotechnology Information. Accessed June 23, 2021. <https://pubchem.ncbi.nlm.nih.gov/compound/Mustard-gas>.

Sageman, Marc and Terrance Leighton, Lloyd Hough, Hidemi Yuki, Rui Kotani and Zachary M. Hosfor, "Aum Shinrikyo Insights into How Terrorists Develop Biological and Chemical Weapons," *Centers for a New American Security*, July 2011: Pg. 1-68.

Schmitt, Eric. "ISIS Used Chemical Arms at Least 52 Times in Syria and Iraq, Report Says (Published 2016)." *The New York Times - Breaking News, US News, World News and Videos*. Last modified November 22, 2016. <https://www.nytimes.com/2016/11/21/world/middleeast/isis-chemical-weapons-syria-iraq-mosul.html>.

Skinner, Harold. "Shell | International Encyclopedia of the First World War (WW1)." 1914-1918-Online. *International Encyclopedia of the First World War (WW1)*. Accessed June 17, 2021. <https://encyclopedia.1914-1918-online.net/article/shell>.

Smith, Saphora. "Down but Not Out: Why ISIS Will Still Be a Threat in 2018." *NBC News*. Last modified December 27, 2017. <https://www.nbcnews.com/storyline/isis-terror/isis-will-remain-threat-2018-experts-warn-n828146>.

Staff, Reuters. "U.S. Says ISIS Evolved to Become a Global Network That Inspires Attacks Worldwide." *U.S.* Last modified June 24, 2020. <https://www.reuters.com/article/us-usa-security-extremists/u-s-says-isis-evolved-to-become-a-global-network-that-inspires-attacks-worldwide-idUSKBN23V2CT>.

Strack, Columb. "The Evolution of the Islamic State's Chemical Weapons Efforts – Combating Terrorism Center at West Point." *Combating Terrorism Center at West Point*. Last modified January 12, 2018. <https://www.ctc.usma.edu/the-evolution-of-the-islamic-states-chemical-weapons-efforts/>.

Tankel, Stephen. "Lashkar-e-Taiba Capable of Threatening U.S. Homeland." *Carnegie Endowment for International Peace*. Last modified June 12, 2013. <https://carnegieendowment.org/2013/06/12/lashkar-e-taiba-capable-of-threatening-u.s.-homeland-pub-52081>.

Tucker, David. "Terrorism, Networks, and Strategy: Why the Conventional Wisdom is Wrong." *Homeland Security Affairs* 4, Article 5 (June 2008). <https://www.hsaj.org/articles/122>

Tucker, Jonathan B. "Chapter 14: Lessons from the Case Studies." In *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, 267. Cambridge: MIT Press, 2000.

Tucker, Jonathan B. "The Future of Chemical Weapons." The New Atlantis. Last modified September 26, 2020. <https://www.thenewatlantis.com/publications/the-future-of-chemical-weapons>.

Warrick, Joby. "Exclusive: Iraqi scientist says he helped ISIS make chemical weapons." The Washington Post. Last modified January 21, 2019. [https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd\\_story.html?noredirect=on](https://www.washingtonpost.com/world/national-security/exclusive-iraqi-scientist-says-he-helped-isis-make-chemical-weapons/2019/01/21/617cb8f0-0d35-11e9-831f-3aa2c2be4cbd_story.html?noredirect=on).

Warrick, Joby. "How the Pentagon Got Inside ISIS' Chemical Weapons Operation—and Ended It." POLITICO. Last modified February 27, 2021. <https://www.politico.com/news/magazine/2021/02/27/red-line-book-excerpt-chemical-weapons-syria-471784>.

Warrick, Joby. "ISIS used chemical weapons on Iraqi prisoners, U.N. investigators find." The Washington Post. Last modified May 13, 2021. [https://www.washingtonpost.com/national-security/isis-chemical-weapons-experiments-mosul/2021/05/13/bbfebf0-b42e-11eb-a980-a60af976ed44\\_story.html](https://www.washingtonpost.com/national-security/isis-chemical-weapons-experiments-mosul/2021/05/13/bbfebf0-b42e-11eb-a980-a60af976ed44_story.html).

Warrick, Joby. "Use of weaponized drones by ISIS spurs terrorism fears." The Washington Post. Last modified February 21, 2017. [https://www.washingtonpost.com/world/national-security/use-of-weaponized-drones-by-isis-spurs-terrorism-fears/2017/02/21/9d83d51e-f382-11e6-8d72-263470bf0401\\_story.html](https://www.washingtonpost.com/world/national-security/use-of-weaponized-drones-by-isis-spurs-terrorism-fears/2017/02/21/9d83d51e-f382-11e6-8d72-263470bf0401_story.html).

Wojcik, Daniel. "Embracing Doomsday: Faith, Fatalism, and Apocalyptic Beliefs in the Nuclear Age." *Western Folklore* 55, no. 4 (1996), 297. doi:10.2307/1500138. Pg. 298.

Wood, Graeme. "What ISIS Really Wants." The Atlantic. Last modified February 15, 2015. <https://www.theatlantic.com/magazine/archive/2015/03/what-isis-really-wants/384980/>.

Zalesny, Mary, Paul Whitney, and Amanda White. "A Conceptual Model to Identify Intent to Use Chemical-Biological Weapons." *Journal of Strategic Security* 10, no. 3 (2017), 54-86. doi:10.5038/1944-0472.10.3.1612.

## **Curriculum Vitae**

Patrick Lucey was born in 1985 in Colorado Springs, CO. He graduated with a BS in Mathematics from The College of William and Mary in Williamsburg, VA in 2008. He enlisted into the U.S. Army in 2010 as an infantryman. During his enlistment, he completed a MA in Security Studies from American Military University. Upon leaving military service, he attended George Mason University in Fairfax, VA and completed a MA in Biodefense in 2017. In 2015, he became an intelligence analyst for the Department of Defense. He anticipates graduating in August 2021 with a MA in Global Security Studies from Johns Hopkins University in Washington D.C.