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The rise of ISIS in Iraq in 2014 was based on a massive intelligence failure due to lack of HUMINT sources on ground and a widening security gap owing to the U.S. military's withdrawal in 2011. Artificial intelligence (AI) could have averted the formation of ISIS in Iraq by alerting decision makers through predictive analytics, natural language processing, and adaptive sensing, all of which could have formed the basis of an early warning system.

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How AI Could Have Curbed the Rise of ISIS in Iraq

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OF THE REQUIREMENTS FOR THE DEGREE OF  
MASTER OF MILITARY STUDIES

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## EXECUTIVE SUMMARY

**Title:** How AI Could Have Curbed the Rise of ISIS in Iraq

**Author:** Mahvash Siddiqui

**Thesis:** The rise of ISIS in Iraq was an intelligence and military failure that could have been prevented; the United States can leverage artificial intelligence (AI) tools to augment the command and control of decision-makers in war zones to predict and disrupt the rise of bad actors like ISIS.

**Discussion:** The 2014 rise of ISIS in Iraq was the product of a massive intelligence failure. The lack of ground-based HUMINT sources and a widening security gap after U.S. military withdrawal in 2011 created a critical intelligence vacuum. ISIS's threats against Iraqi critical infrastructure and subsequent stronghold in Iraq threatened the lives of innocent civilians. These threats might have been averted with the aid of advanced AI tools that could address the lack of intelligence analysts and military experts. More specifically, AI-based predictive analytics, national language processing, and adaptive sensing tools could augment or supplant on-the-ground analysts and experts, and supply critical intelligence and the decision advantage to strategic decision-makers addressing national security threats.

**Conclusion:** In future conflicts where the premature withdrawal of United States forces and intelligence assets is likely due to political reasons, it may be worthwhile to augment or supplant human intelligence and military assets with a combination of geospatial-intelligence assets, cheap sensors, and robust AI frameworks to serve as an early warning system. This helpful combination of intelligence and technology will enable decision-makers the time and space to strategically address national security threats and scope their interventions, particularly in war-torn and vulnerable regions.

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## PREFACE

ISIS attack of Iraq's Mosul Dam in June 2014 highlighted one of the biggest intelligence failures of our time. During this period, the lead mission on the ground was U.S. Embassy Baghdad under U.S. Department of State control, and there was a clear dearth of on-the-ground U.S. military expertise to tackle critical infrastructure concerns. The Office of Military Cooperation and the Defense Attaché at the Embassy had a contingent of 120 personnel who were mainly involved in foreign military sale. None possessed expertise in dams or water issues. In my capacity as a Foreign Service Officer and Embassy Baghdad's Environment, Science, Technology, and Health Officer, the Ambassador appointed me the 'resident expert on Mosul Dam,' as water issues were part of my portfolio.

While I did not have expertise in dam hydrology nor the tools to report on the status of critical infrastructure in Iraq, my new duty was to provide daily status reports on the Mosul Dam to National Security Advisor Susan Rice. Among other things, the reporting assessed whether U.S. military intervention was necessary, and if so, how quickly such need would arise. The National Security Council (NSC) had concerns that ISIS may breach the enormous dam, which could immediately cause a massive flooding catastrophe. Such a breach had the potential to affect eight million Iraqis directly in the dam's flow path and lead to an immediate mass-casualty situation due to the resulting powerful tsunami-like waves.

Despite limited resources, I leveraged the agencies and specialists available to the Embassy at the time. Among them was the National Geospatial-Intelligence Agency — a combat support agency and intelligence community member — who provided me maps and detailed imagery of the Mosul Dam and ISIS chokepoints. These invaluable practical resources helped me determine the far-reaching impacts of a potential dam breach, confirm the NSC's concerns,

and allowed me to credibly convey the situational urgency to stakeholders in the NSC and CENTCOM to take timely and decisive military action.

While it was a huge honor and privilege to serve our country and be a part of the team that prevented ISIS from taking over Mosul Dam, I believe that we were on the brink of crisis had luck not been on our side. The onerous burden of reporting and tactical decision-making fell on the shoulders of the Embassy's diplomatic corps — primarily myself. Though my efforts were successful in averting a Mosul Dam-related disaster, ISIS did unfortunately make significant progress in Iraq and cause damage to the U.S. Iraq mission. However, if we had access to a greater amount of intelligence, the rise of ISIS in Iraq and its subsequent take-over of critical infrastructure could have all been averted. The emergence of ISIS presented a deep intelligence gap in our understanding of the threats in the region. In future war zones, the lack of HUMINT combined with lack of military expertise on the ground could be easily replaced with a robust Artificial Intelligence system for decision-making. I thus argue in this paper that where intelligence gaps exist, they should be filled with technological aids — particularly Artificial Intelligence — to serve as mechanisms that provide the informational decision advantage for U.S. military decision-makers that are removed from the area of operation (AO). An AI tool could help decide whether to strike or not, and what conditions would serve as the trigger to conduct a military strike on a target of interest. At the least, an AI tool could serve as an early warning system to present decision-makers with astute guidance and an optimized array of options — and all this could be accomplished using information collected by inexpensive sensors, geospatial imagery, and social media and news analysis in place of more resource-intensive intelligence collection capabilities. [I would like to thank my sister Shahtaj Siddiqui, Assistant General Counsel at the National Geospatial Agency for editing this paper. ]

## INTRODUCTION

Making strategic military decisions is an art and a science. The more informed we are of the enemy's actions, the better prepared we are to win a war. Sun Tzu, the famous Chinese military strategist, said: "If you know the enemy and know yourself you need not fear the results of a hundred battles."<sup>1</sup> When Islamic State of Iraq and Syria (ISIS) took over Iraq in June 2014, national security decision-makers in Washington, D.C. were blindsided. Approximately 90,000 Iraqi troops that had been trained by the U.S. Army had suddenly retreated at the sight of ISIS, and Iraq was soon under ISIS's control.<sup>2</sup> Not being able to prognosticate the emergence of ISIS in Iraq was considered one of the biggest intelligence failures of our time.<sup>3</sup> There was a false sense of optimism in the White House and the National Security Council (NSC) that Iraq had regained its stability after we had signed the U.S.-Iraq Status of Forces Agreement and handed the control of Iraq to the newly elected Iraqi government in December 2011.

While the emergence and impact of ISIS was unforeseen, the related intelligence failure was not a result of an intelligence or data gap. Rather, there was a gap in interpreting and weaponizing the raw data. In fact, there was an information overload with hundreds of warning cables from Embassy officials, alerting the NSC and CENTCOM of bad actor activity in Iraq.<sup>4</sup> Moreover, Arabic and Kurdish news media regularly reported on the terrorist attacks in Iraq leading up to ISIS's takeover.<sup>5</sup> In fact, based on open source reporting stemming from Arab news sources, the Global Terrorism Index of 2014 reported that Iraq was the deadliest country in 2013 because of terrorist incidents—"Iraq was the most affected by terrorism in 2013, losing 6,362 victims in almost 2,500 terror attacks."<sup>6</sup> The threat reporting on Iraq, both diplomatic and open source, was voluminous. This, combined with the rapidly proliferating social media output of ISIS, should have been enough to alert the Pentagon. However, there was a glaring lack of

analytical capability to tie one terrorist incident to the other and make sense of the developments given the disparate and gargantuan nature of the data.

The ramifications of this intelligence failure and related second and third order effects were staggering — but could have been avoided. The summer of 2014 proved to be no less than a nightmare for the U.S. government (USG). The U.S. had to send troops back to Iraq to combat ISIS, costing American taxpayers millions of dollars. More critically, ISIS’s stronghold in Iraq endangered thousands of innocent Iraqi civilians.

When the U.S. military withdrew from Iraq in 2011, it should have astutely invested in emerging technologies to keep its eyes and ears on the war zone. The USG would have been well served had it invested in AI technology to compensate for the lack of OSINT, human intelligence (HUMINT), and signals intelligence (SIGINT) assets. Even if we had all these capabilities, making sense of the gargantuan volumes of data needed AI-related technological intervention.

The 2018 U.S. National Defense Strategy identifies AI as one of the key technologies that will “ensure [the United States] will be able to fight and win the wars of the future.”<sup>7</sup> Though difficult to define,<sup>8</sup> AI is “[t]he theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.”<sup>9</sup> According to the TechTarget network (portal for tech experts): Artificial intelligence (AI) is the “simulation of human intelligence processes by machines, especially computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions) and self-correction.”<sup>10</sup> A systematic AI program comprised of predictive analytics, sense-making algorithms, and natural language processing can serve as

an early warning system by accurately recognizing patterns of bad-actor activity and providing early indicators for swift strategic responses.

In the 21st century, intelligence failures do not happen because we lack data, but rather because we are not able to make sense of terabytes of data stemming from land, sea, air, space and cyberspace. More critically, military and political leaders face an explosion of data on a daily basis, particularly data emanating from a chaotic war zone. AI could augment decision-makers synthesizing terabytes of data and compacting the decision-making loop. In Iraq, for instance, an AI-powered “sense-making” tool could have filled the intelligence and analytical gap created by the departure of the U.S. military. When ISIS began taking over Iraqi critical infrastructure including power plants and dams in Fallujah, Samarra and Mosul, an AI system could have sounded the alarm, alerting decision makers to employ countermeasures. Thus, **the rise of ISIS in Iraq was an intelligence and military failure that could have been prevented; the United States can leverage artificial intelligence (AI) tools to augment the command and control of decision-makers in war zones to predict and disrupt the rise of bad actors like ISIS.**

The power of AI for military usage is best articulated by Lt. Gen. Eric Wesley of the Army Futures Command, who said: “A lot of people are attracted to the implications of AI on robotic warfare. I’m less interested in that. We’re talking about synthesizing data, terabytes of data. That includes everything from weather, to social media, to intelligence reports of the enemy’s positions, all of which has to be synthesized across all domains: land, sea, air, space, and cyberspace.”<sup>11</sup>

## **DATA ANALYSIS AND FINDINGS**

### **Artificial Intelligence: Tools and National Security Applications**

#### Overview

Artificial intelligence, more commonly referred to as AI, is a generic term that encapsulates a variety of technologies including machine learning, deep learning, and neural networks. While AI technologies have existed for decades, AI's recent rise and proliferation is a result of a parallel proliferation of Big Data, or "high-volume, high-velocity and/or high-variety information assets that demand cost-effective, innovative forms of information processing that enable enhanced insight, decision making, and process automation."<sup>12</sup> The explosion of web-based technologies, social media, and related user input has contributed to the rise of Big Data. AI technologies feed off of data, much like the human brain learns from data intake from the environment. Thus, AI pertains to "the ability of machines to perform tasks that normally require human intelligence ... recognizing patterns, learning from experience, drawing conclusions, making predictions, or taking action — whether digitally or as the smart software behind autonomous physical systems."<sup>13</sup>

Unlike typical automated systems that are based off of database analysis, AI-based technologies are capable of taking in large amounts of unstructured data — data that does not neatly fit a standard database, like a Twitter feed — and make sense of it. This advanced computational ability clearly has many benefits, and a large variety of applications, as illustrated in Figure 1. There are three key areas, however, that most lend themselves to military applications in a war zone (aside from intelligent robots). These key technologies are: natural language processing, sentiment analysis, and affective computing.

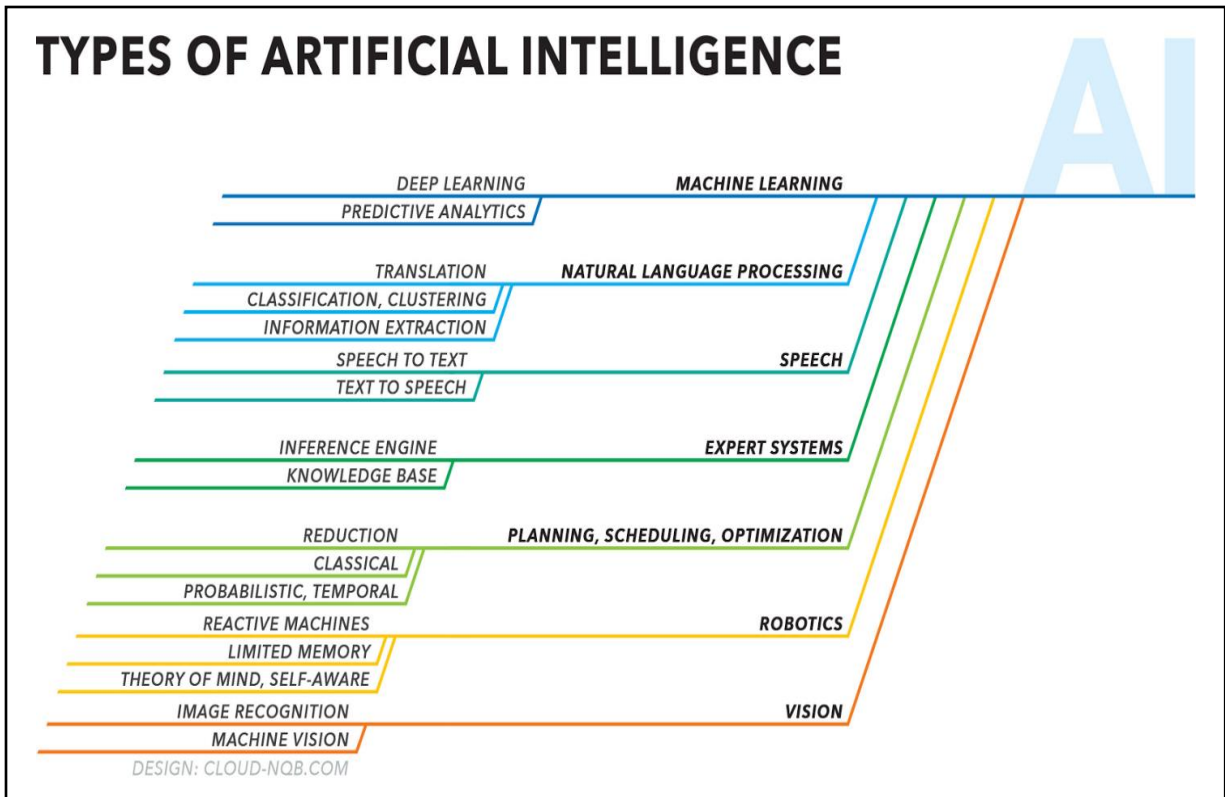


Figure 1: Types of Artificial Intelligence<sup>14</sup>

### Natural Language Processing

Natural language processing (NLP) is “a field of computer science, artificial intelligence, and computational linguistics” concerned with the interactions between computers and human (natural) languages.<sup>15</sup> NLP “allows people’s conversations, ideas and emotional states to be captured, stored and processed as data.”<sup>16</sup> In a March 15, 2019 lecture on ‘Hyper War and Emerging Technologies’ at the Marine Corps University, General Allen, former Commander of the NATO forces in Afghanistan, highlighted the importance of using NLP to understand the enemy and the battle terrain.<sup>17</sup> Knowing that our understanding of foreign languages is limited to professional level at the most, and knowing that the enemy would use native-level nuanced

language to communicate, General Allen recommended the use of NLP to enhance the friendly forces' kill chain to understand and deter/disrupt enemy action.

### Sentiment Analysis

Sentiment analysis is a type of AI that “seeks to understand the general attitude, meaning or opinion behind text or other types of content such as videos.”<sup>18</sup> The purpose of sentiment analysis is to distill metrics from vast quantities and disparate qualities of data such as a variety of social media posts. For instance, data scientists have been able to predict future disease outbreaks by developing algorithms that “harvest large-scale digital histories, encyclopedias, social and real-time media, and human web behavior to calculate real-time estimations of likelihoods of future events.”<sup>19</sup> A similar pattern analysis program could have provided an early warning signal telling the USG that Iraq’s stability was spiraling down rapidly.

### Affective Computing

Affective computing is a type of AI that “seeks to understand and use emotion. It is the machine equivalent of emotional intelligence in humans.”<sup>20</sup> AI can detect human emotions based on factors including “facial expressions, tone of voice, word usage or other inputs such as the way someone is typing or their body temperature.”<sup>21</sup> For instance, affective computing is used to monitor the body language of concert attendees for security purposes at concert venues, and has proven to be an effective tool in predicting and preventing threats.<sup>22</sup>

### **Embassy and News Media Reporting Were Insufficient to Signal the Rise of ISIS in Iraq**

As an Environment, Science, Technology and Health (ESTH) officer in Iraq in early 2014, I had sent several warning cables to the NSC and Iraq watchers about saboteur activity on critical infrastructure in Iraq. The first cable was about the sabotage of Fallujah Barrage in Western Iraq that had blocked the flow of Euphrates to Southern Iraq while flooding Iraqi

artillery bases.<sup>23</sup> This was followed by reporting on the sabotage of oil fields in Iraq-Kurdistan border that had polluted the Tigris.<sup>24</sup> I also sent critical reporting on the smuggling of radioactive waste from a decommissioned nuclear power plant in Tuwaitha,<sup>25</sup> penetration of a decommissioned chemical plant by Iraq-Syria border by foreign bad actors,<sup>26</sup> and on the impending threat of breach of the Haditha Dam, whose destruction could cause catastrophic tsunami-like waves.<sup>27</sup> Similarly, there were several political officers at the Embassy reporting on riots, car bombings, and the sabotage of critical infrastructure and disruption of essential services caused by bad actors.

At the time, neither my fellow diplomats nor I were aware that there was a common bad actor emerging from the reporting. Surprisingly, this pattern of development was also not discovered by intelligence analysts in Washington either. Almost in synchronization with the diplomatic reporting, Arab news media flooded the airwaves with coverage of bad actor activity in Iraq, incidents that varied from car bombings to the burning of oil fields. However, given that there was lack of international news coverage by English-language world media such as CNN and BBC, the NSC and other decision-makers did not pay heed to the developments, and there was a general assumption that Iraq was stable.<sup>28</sup> After the fact, the Embassy discovered that the common thread behind these saboteur acts was a Syria-based foreign fighter group that had teamed up with Sunni dissidents and former Baathists who were disenfranchised by US-backed Iraqi PM Maliki. By June 17, 2014, after causing 90,000 Iraqi troops to retreat, ISIS had taken over Mosul Dam and started speeding towards the Green Zone in Baghdad — where the U.S. Embassy with its 5,000 personnel were located.

In a September, 2014 interview on CBS's "60 Minutes," President Barack Obama said that the USG had underestimated the threat of ISIS.<sup>29</sup> Then White House Press Secretary, Josh

Earnest, added that “nobody predicted the speed and pace” of ISIS’s capture of Iraq.<sup>30</sup> However, Syria’s Deputy Foreign Minister, Faisal Mekdad, told NBC News that the United States should not have been surprised by ISIS, and that Syria had been warning the U.S. about ISIS for three years.<sup>31</sup> Given credibility issues with Syria, the United States’ reticence in relying on Syrian information is understandable. However, AI tools could have helped USG decision-makers and State Department officials discern between credible and unreliable sources of information to predict the emergence of ISIS. The USG could have leveraged AI tools like natural language processing, sentiment analysis and affective computing to sift through the volumes of information produced by the Embassy and Arabic news media to stop ISIS from developing into a formidable threat in subsequent years.

### **Pattern Analysis, Sentiment Analysis, and Image Recognition Could Have Signaled Imminent ISIS Threat**

Social media and Arab media provided ample data for automated analytical tools to predict the rise of ISIS. First, ISIS’s social media activity usage was prolific. In fact, a Stanford University study reported that ISIS’s social media usage to engage targeted audiences and recruit new followers was far higher than average at the time.<sup>32</sup> Using an NLP-based algorithm, the Pentagon and intelligence agencies could have scoured asymmetric data on bad actor activity in Iraq stemming from various conduits including State Department cables, social media and open source data including Arab and regional news media. A fine-tuned NLP algorithm could process Arabic, Kurdish, Turkish, or Farsi news and social media content to a digestible English language format for decision-makers to manage. Additionally, on the SIGINT side, ISIS’s cellular, radio, or electronic communications could have been processed and packaged by an NLP algorithm in a digestible English-language format for analysts and decision-makers to utilize.

Furthermore, several news and research articles have been written about Saddam's military tactics including using water as a weapon of war. In the 1990s, Saddam avenged his Shiite enemies in Southern Iraq by drying out the marshes in Basra.<sup>33</sup> Had we paid attention to recorded history, a lot of which is available online, using pattern analysis, we could have figured out that ISIS may use a page from Saddam's notebook by using water as a weapon of war. After the fact, the USG acknowledged that PM Maliki was creating the right conditions to destabilize Iraq by disenfranchising Sunnis and former Baath party dissidents in the Anbar Province. A pattern analysis algorithm studying local news coverage in Iraq would have alerted the USG to engage and advise the Iraqi Government to steer in a more positive direction.

Moreover, sentiment analysis could have been aptly used to discern ISIS's broader intentions to expand its influence in Iraq, through its volumes of Arabic and other foreign language social media videos and Twitter feeds. After all, Embassy officials often reported in cables content from the local news that highlighted rampant bombings, sabotage of power plants and infrastructure, and complaints from Sunni municipal leaders about lack of essential services. These cables that synthesized local news coverage were read by the Iraq Desk at the Department of State but did not necessarily pass muster to gain high-level attention. However, a tailored DOD-driven AI sentiment-analysis program could have drawn attention to richer and more critical data on Iraq's rapidly plummeting stability, enough to warrant NSC intervention in the arena.

During the millions of dollars' worth of reconstruction work that the DOD had conducted in Iraq, there had been talks of fortifying the twenty-four border security checkpoints in Iraq with x-ray machines and radio-nuclear device detectors.<sup>34</sup> Had the DOD enhanced security checkpoints in Iraq with inexpensive sensors and simple facial image recognition systems, the

movement of ISIS operatives could have been tracked. Moreover, the operatives' body language could have been studied using affective computing, providing another layer of intelligence regarding their motivations in the region. Affective computing combined with machine learning — essentially training the facial recognition cameras to recognize certain images and faces as seen in ISIS Twitter feeds — could have helped us apprehend ISIS entities during their entrance or exit from Iraq.

### **AI's Role in Decision-Making: Compressing the OODA Loop**

During times of war or crisis, military leaders are burdened by masses of information from various sources — some credible and some not. AI is a requisite tool to help military leaders solve problems by sorting through the large quantity of data and finding early and reliable indicators to make critical strategic decisions. In Iraq, an AI tool could have alerted the Pentagon to send the requisite number of troops and DOD experts to thwart bad actor activity before the trouble-zone expanded. AI would have been the right tool to shrink the decision-making cycle or “object, orient, decide and act” (OODA)<sup>35</sup> loop of the senior defense officials in Iraq<sup>36</sup> and the accompanying embassy task force.

As post-ISIS news reports suggest, there was an intelligence failure on the part of the USG.<sup>37</sup> Knowing the general terrain of Iraq, the USG should have deployed data scientists to mine the Web and airwaves for any and every OSINT, HUMINT, SIGINT, GEOINT source on Iraq. Based on that information, we could have used an AI tool leveraging adaptive sensing combined with predictive analytics to more quickly recognize that Iraq was among the top 25 unstable countries in the world after the departure of the U.S. military in 2010 — and that it needed our utmost attention.<sup>38</sup> In fact, Iraq ranked 13 on the list of most fragile countries compiled by Fund for Peace.<sup>39</sup> By prematurely departing from Iraq in 2010 and leaving a

security void, we allowed bad actors to overwhelm the country, costing us millions of dollars accompanied with high anxiety to quell the metastasizing threat of ISIS on Iraq’s civilian population. In place of the U.S. military assets that left Iraq — including U.S. Army Corps of Engineers (USACE) and critical DOD Political Advisors — we should have deployed AI as a tool to serve as an early warning indicator to protect our reconstruction efforts and U.S. interests in Iraq, in addition to Iraqi critical infrastructure.

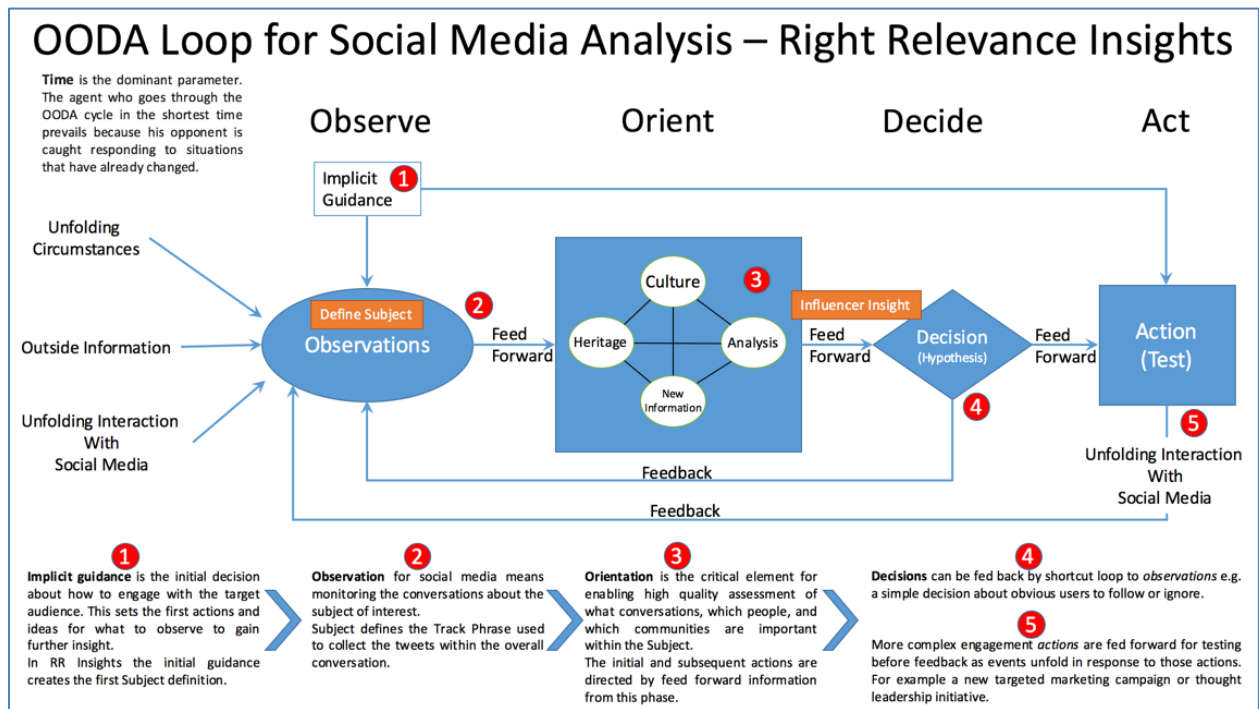


Figure 2: OODA Loop for Social Media Analysis<sup>40</sup>

### Fallujah Barrage: Using AI Could Have Stemmed ISIS’s Emergence and Expansion

The Fallujah Barrage is “a barrage [dam] on the Euphrates near Fallujah in Al Anbar Governorate, Western Iraq.”<sup>41</sup> The Southern population of Iraq relies on fresh water supplies from the Euphrates for agriculture irrigation, one of the primary livelihoods. Taking a page from Saddam’s notebook to use “water as a weapon of war” in a water-starved region like Iraq, insurgents (Sunni dissidents, former Baathist, and foreign fighters) took over the Fallujah

Barrage in April 2014. In the 1990s, Saddam wanted to subdue a Shiite insurgency in the fabled Marshlands in Basra, Iraq, also previously known as the bread-basket of the world.<sup>42</sup> He ordered the placement of dykes to block the trajectory of Tigris that fed into the Marshlands, ultimately drying the Marshlands that fed the Basrawites while killing the economic prospects of the region, including wildlife, fisheries, dairy and wheat production.<sup>43</sup> Modernly, the foreign militant group blocked the Fallujah Barrage with two dykes to ensure that water from the Euphrates did not flow down to Southern parts of Iraq<sup>44</sup> — particularly towards Basra and its burgeoning oil industry where several Western oil companies including BP, Shell and Chevron own petroleum refining plants.<sup>45</sup>

Blocking the barrage was a symbol of economic terrorism, as Iraq's economy is dependent on oil, making Iraq the third largest exporter of oil in the world.<sup>46</sup> For instance, in 2017, "Iraq exported \$61.5 billion worth of the commodity, which accounts for 7.3% of global exports."<sup>47</sup> Water from the Euphrates River is critical for Iraqi/Western oil refining and processing. Without fresh water supplies, petroleum refineries could not function.<sup>48</sup>

In addition to Western and Iraqi oil interests being threatened by the blockade of the barrage, Iraqi critical infrastructure was also threatened. The blockade stopped water flow to the South while diverting a spate of water eastward towards Baghdad, causing agricultural areas and Iraqi artillery bases with U.S.-made artillery to be flooded, while causing a drought in Southern parts of the country. Given a threat to Iraqi national and economic security, PM Maliki called upon the Office of Security Cooperation-Iraq (OSCI) for help. The blockade affected U.S. and Iraqi interests, in response to which the Embassy created a 'Fallujah Barrage Task Force' (FTF) to handle the problem.

Prior to the U.S. military withdrawal in 2010, the USACE and the U.S. Geological Survey were in charge of water issues and critical infrastructure reconstruction projects. However, because there was no USACE water expert on the ground in 2014, the OSCI's Commanding General had to exploit any resource available to him. He reached into the Embassy's cadre of diplomats and assigned me the role of a quasi-hydrologist role, as I was the Embassy's ESTH officer who handled water and environment issues.

The FTF comprised of non-specialists or generalists whom OSCI tasked to make acute specialist-like decisions on the impact of the blocked barrage on Iraqi critical infrastructure and national security. In a desperate plea for help to revive their oil economy after Fallujah Barrage blocked the flow of water to the oil industry, PM Maliki asked OSCI for an explosive device to blow up the Barrage. The OSCI tasked the Embassy's Fallujah Barrage task force to analyze the impact and repercussions of all potential alternatives before getting back to PM Maliki. The Iraqi Ministry of Water resources provided us their water management schematic (See Figure 3) to seek a solution from us to replenish their oil fields with fresh water supplies and prevent flooding of agricultural areas. At the time, the Iraqi government's only solution was to blow up the barrage without considering the ramifications and possible collateral damage.

To start with, the FTF was tasked to create maps of the barrage and surrounding areas for decision makers as well as provide daily flood levels, status of barrage gates, and overall impact. As part of FTF, I enlisted the services of the National Geospatial-Intelligence Agency (NGA) support team embedded in the Embassy to capture imagery of the Fallujah Barrage to assess the damage to the flooded and drought-ridden areas. The FTF was desperate for technological resources to scientifically analyze the hundreds of images provided by NGA to assess the extent

of damage. Additionally, I reported to the NSC the political climate in Fallujah, highlighting foreign militant activity and a Sunni insurgency that could potentially grow.

To best recommend a pragmatic solution to the Iraqi government, AI would have been a beneficial tool to weigh the costs versus benefits of alternative solutions. AI that leverages a pattern recognition algorithm would have been a key resource in making sense of the hundreds of pre and post-flooding photos of the Iraqi landscape east of Fallujah. Pattern recognition is the automated recognition of patterns and regularities in data.<sup>49</sup> AI would have helped us figure out various permutations and combinations to re-route water from the Euphrates through other dams that supply the Southern provinces of Iraq. In fact, we could have used AI technology such as Project Maven<sup>50</sup> to fine-tune the NGA-processed imagery (accurately target ISIS via drones). Given that dam engineering is an art and science in itself, the calculation of complete datasets and variables to determine the path of least resistance for flow of water requires complex math and physics training, which only a trained hydrologist could accomplish using robust software. However, in a war zone environment where there is a lack of subject matter expertise on critical infrastructure such as dams, it is astute to augment decision makers with AI solutions, so non-specialist subordinates can recommend military-related solutions when such expertise is missing.

However, we failed to capitalize on this. Fortunately for us and the Iraqis, through an act of nature, a high current of water managed to divert the dykes away, unblocking the Fallujah Barrage's blocked gates and allowing the water to flow normally through to Basra which gradually relieved the flooding. Had this situation lasted beyond a month, Baghdad's relevant ministries were bracing for a drought and a huge impact on their oil economy, which would have affected global oil prices given that Iraq is a member of OPEC.<sup>51</sup>

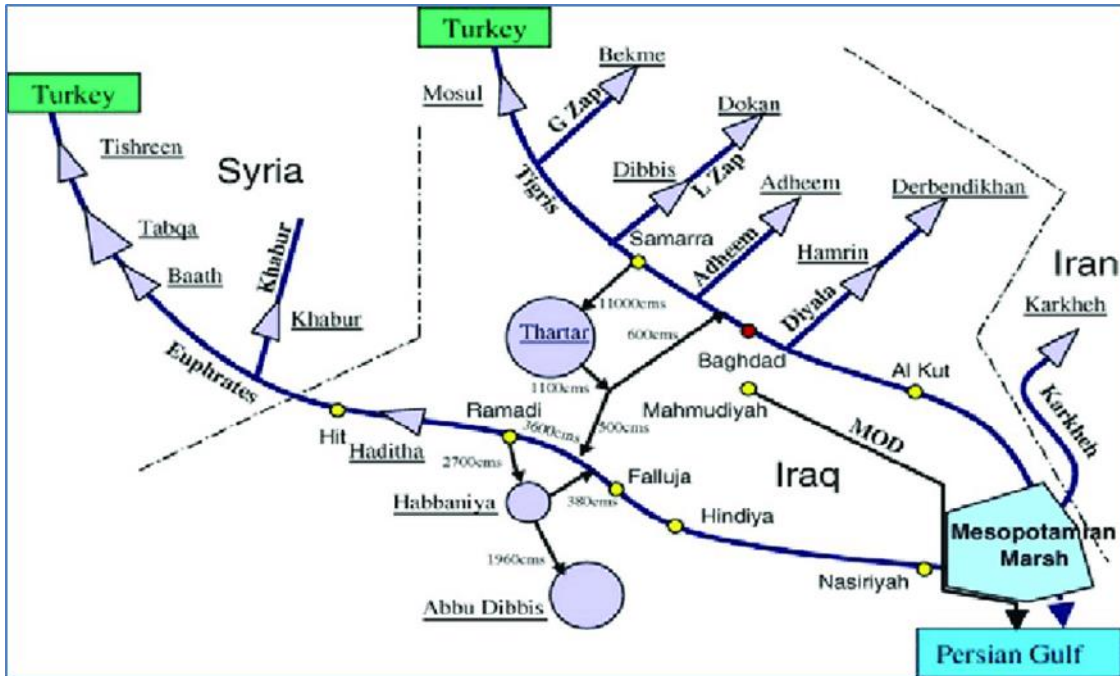


Figure 3: Iraq's Water Management Schematic, courtesy of Iraq's Ministry of Water Resources<sup>52</sup>

The case of the sabotage of Fallujah Barrage by ISIS serves as an example of where an AI-related early warning system could have helped us prevent ISIS expansion in Iraq. While an act of nature averted disaster and dampened the ISIS's activity in Fallujah, the FTF was unable to accurately predict ISIS's next moves or which critical infrastructure would next be at risk. ISIS was in fact using Saddam's playbook of using water as a weapon of war, as a huge number of ISIS principals were Baath party dissidents<sup>53</sup> or Saddam's loyalists who were driven to the Anbar Province by the majority Shiite government of Iraq. While Baathists were nationalists and secularists by nature, but Sunni by background, they colluded with ISIS because of disenfranchisement by PM Maliki and the Iraqi Shiite-majority government — their common enemy.

AI-leveraged predictive analytics would have scoured Web and intelligence databases for this information and helped us understand the playbook of ISIS. Instead of relying solely on our

human judgment, using predictive analytics form of AI would have helped with our OODA loop. It would have helped us expertly guide the Iraqi Ministry of Defense to preempt and disrupt ISIS's future moves. While the best of diplomats on the ground in Embassy Iraq could foresee that this was not the end of ISIS, it was hard for us to make a scientific judgment on what to expect next. What we were not able to foresee was that ISIS decided to capture other major dams in Iraq starting with Samarra,<sup>54</sup> to the point where the weight of national security of Iraq began to weigh on our shoulders. Any wrong decision taken could cost untold damage including civilians' lives.

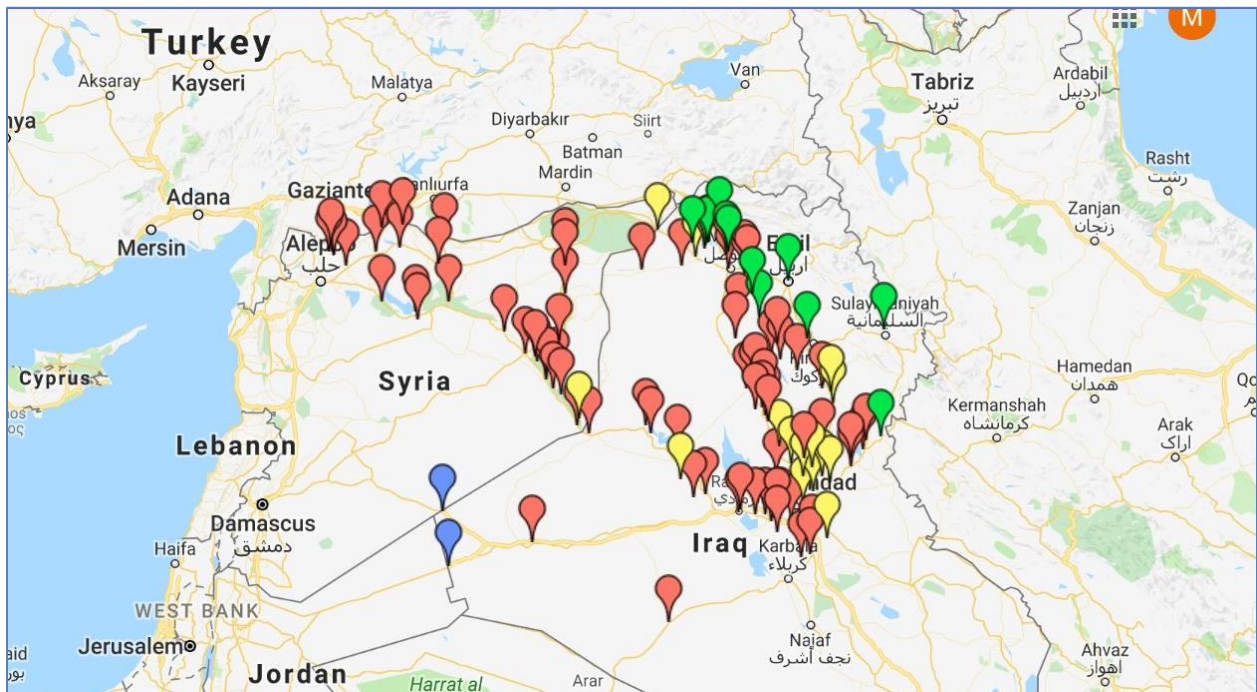


Figure 4: Cities Occupied by ISIS by June 12, 2014<sup>55</sup>

### **Mosul Dam: Using AI Would Have Helped Fill the Gap of U.S. Military's Critical Infrastructure Experts**

Utilizing AI-assisted predictive analysis, we could have accurately projected that the next big target for ISIS was the Mosul Dam. From Fallujah Barrage, ISIS had moved to

unsuccessfully attack Haditha Dam (the second largest dam in Iraq, located near the Euphrates River),<sup>56</sup> and then finally taken over Samarra Dam, a critical dam for agricultural purposes in middle Iraq.<sup>57</sup> On June 17, 2014, ISIS not only took over Northern Iraq — causing 90,000 Iraqi troops to desert their army — but was also speedily heading towards the U.S. Embassy 800 kilometers southward. Fortunately, an attack on the Green Zone was deterred by Iranian Shiite militias aiming to protect Shiite holy shrines, thus pushing ISIS back to a stronghold in Northern Iraq near Mosul Dam.<sup>58</sup>

In a matter of weeks, however, ISIS captured Mosul Dam, causing widespread concerns of a potential dam breach. According to several expert hydrologists, a breach of Mosul Dam would cause a rush of water affecting 7 million people within a range of 7000 kilometers.<sup>59</sup> Because of the Mosul Dam's inherent nature to self-breach, a 2006 USACE report established that the "Mosul Dam is the most dangerous dam in the world."<sup>60</sup> The situation became even more precarious since ISIS took control of the Dam in 2014. Many of the 1,500 workers stationed there fled, and ISIS damaged most of their equipment. Out of the 1500 workers, there were 36 key grouters whose main job was to fill the cracking gypsum foundation with Bentonite. By USACE estimates, Dam failure would produce a 39-to 50-foot wave of water that would hit Mosul, Iraq's third largest city, in less than four hours. The wave would continue south along the Tigris impacting people and places for more than two days before crashing through Baghdad at a height between 10 and 20 feet. The potential for loss of life and property destruction was described as 'Biblical' by a hydrologist.<sup>61</sup> Professor Nadhir al-Ansari of the Environmental Engineering Department at Lulea University in Sweden, who inspected the initial construction of the dam said, "It is just a matter of time. It will be worse than throwing a nuclear bomb on Iraq."<sup>62</sup> The USACE surmised that a Mosul Dam failure could result in "400,000 lives lost, an

economic loss of \$20 billion, and create a regional stability and security crisis well beyond the manmade variety.”<sup>63</sup>

The NSC appointed me as the ‘Resident Expert on Mosul Dam’ at the U.S. Embassy, as there were no USACE hydrologists present on the ground and I had some experience on dam-related matters being part of the FTF. My job was to provide frequent updates on the dam to Susan Rice (National Security Advisor) via cable and phone and help the U.S. military (CENTCOM) virtually assess if U.S. forces were needed on the ground to avert a possible ISIS-inflicted dam breach.<sup>64</sup> I was fortunate to have advanced training in physics, which helped me calculate daily water levels in the dam through an extrapolation of historical data (piezometer readings) provided by the Iraqi dam manager who was in hiding, and by assessing NGA imagery. Even USACE experts in CENTCOM HQs were not able to provide an accurate analysis on the dam’s vulnerability given the thousands of satellite images they had to mine through with varying resolutions — which could have been skillfully sifted through had an AI-assisted GEOINT imagery analysis tool been employed.

The biggest concern for the USG was that the dam was built on a foundation of gypsum, a soluble compound, which could cause the dam to self-breach within a given period of time.<sup>65</sup> Some analysts estimated that the dam could breach in 7 days if un-grouted, while other assessments gave a generous assessment of 30 to 40 days. The dam needed frequent grouting with the use of bentonite, a naturally available resource in Northern Iraq, which was also under ISIS’s control. Part of my job was to find alternate sources and locations of bentonite for grouters to patch the dam, which was an onerous task in itself as only a trained geologist in Iraq would know such specifics. In this case, AI could have helped in scouring available information sources on nearest foreign or domestic bentonite suppliers.

On a normal day, the dam manager and 36 grouters would look for rifts or cracks in the Mosul Dam's soluble gypsum foundation using an x-ray diffraction method and grout the dam with bentonite where obvious cracks appeared. The escaped Mosul Dam manager willingly shared months of data on fractures found in the dam. Here, AI-assisted predictive analysis could have thoroughly analyzed the dam's mechanical engineering parameters to assess its vulnerability to self-breaching. However, we did not possess AI assets, and instead received disparate assessments from various intelligence communities and USACE, almost in an unorthodox manner. When ISIS took over, most of the grouters fled the dam while the four who stayed behind were killed. In addition to this critical situation, we also had to determine the best military solution to secure the dam without accidentally breaching the dam under friendly fire. This task required strong computational skills, including superior knowledge of the Mosul Dam's hydrology.

Ultimately, the Embassy recommended estimates based on Iraqi dam experts' analysis that the dam would be stable within a 40-day period without grouting. The estimate the Embassy recommended to the NSC was based on Iraqi engineering expertise. However, we had our doubts given that there was a vast degree of variation amongst all dam-vulnerability estimates. In such a situation, with lack of U.S. military capabilities on ground, an AI tool would have provided the most reliable metric for vulnerability. Such a predictive analytics capability could have provided rapid and accurate dam analysis given the various moving parts.

In August 2014, the dam breach was finally averted, owing to coordinated action by the U.S. military and the Kurdish Peshmerga infantry force. The combined military forces were guided using NGA assets that helped determine the chokepoints and strategic attack zones, followed by supporting airstrikes on the dam. Airstrikes to regain the dam from ISIS could have

been more precise had we used the help of AI to better distinguish targets instead of mistargeting friendly assets. A tool similar to Project Maven would have helped accurately find chokepoints on the Mosul Dam, while inflicting minimal damage to Peshmerga allies and dam infrastructure.<sup>66</sup> Looking back, it would have been more astute for the U.S. military to have used AI-assisted predictive analytics as a stop-gap measure to rid the dam of ISIS potential threats and protect Iraqi critical infrastructure.

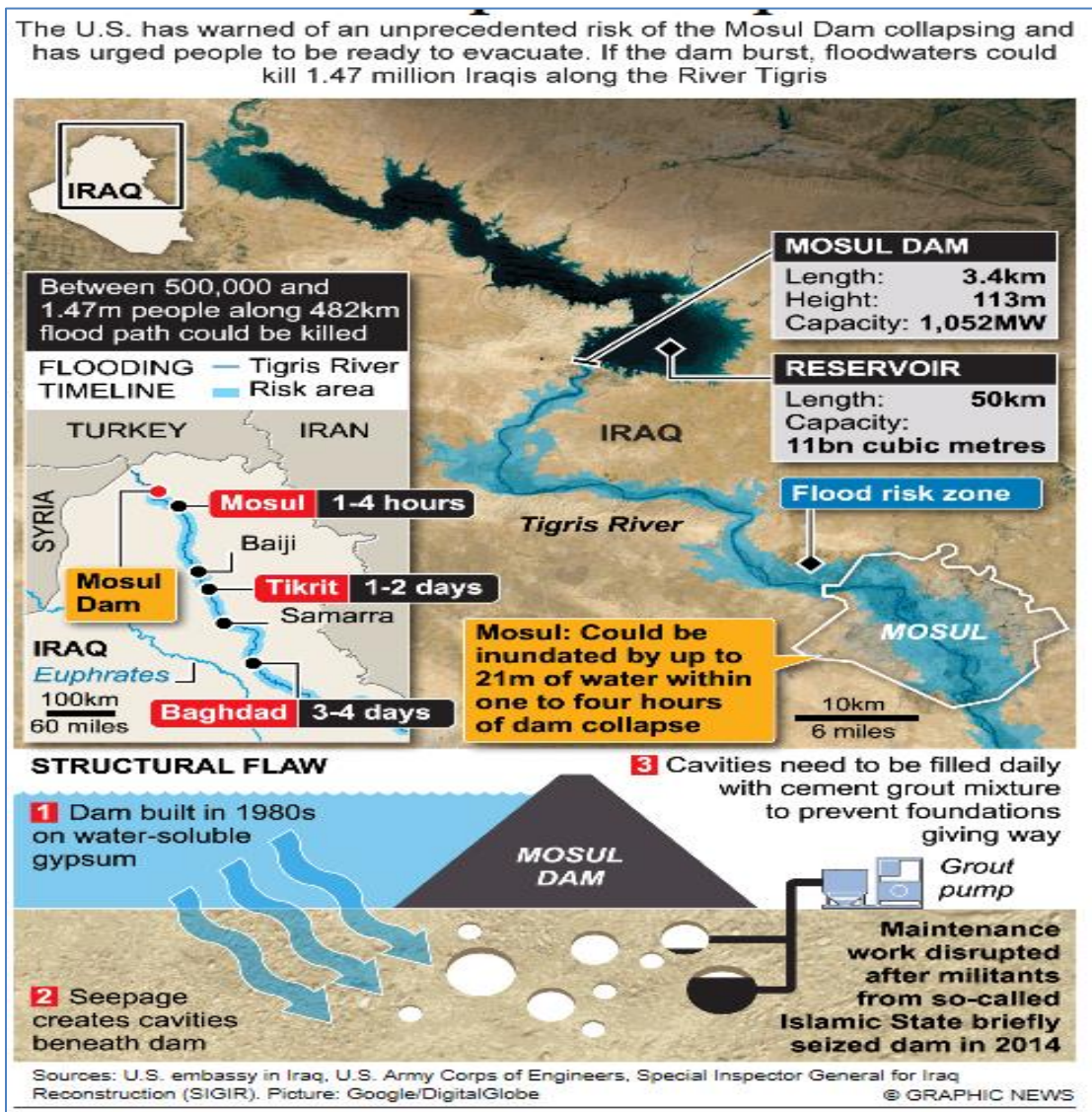


Figure 5: Flood risk areas along River Tigris and technical details on Mosul Dam.<sup>67</sup>

## **RECOMMENDATION/CONCLUSION:**

The United States, despite its powerful military, ends up losing decisive battles, as we are not strategic in our approach. Despite our military might, we tend to lack strategic and tactical intelligence of terrains we invade. Contrary to Sun Tzu's wisdom about "knowing thy enemy," we tend not to know our enemies well. As the battles and wars become more complex and situated in urban terrain, strategic intelligence about the enemy is vital to our interests. Instead of being blindsided by the formation of ISIS in Iraq, we could have been better prepared to avert ISIS had we followed the pattern of activity or better yet trained a machine to serve as an early warning system. We should not have been surprised when Sunni dissidents in Fallujah or ISIS in Mosul decided to use water as a choice weapon of war. This behavior was a replica of Saddam's action against the Shiite dissidents in the South, where he blocked their use of the Tigris with two dykes and killed the marshland economy in Basra in the 1990s.

Though analyzing historical trends were not a factor in strategic calculations for the U.S. response to ISIS, we could have deployed an algorithm to do predictive analysis on a vast array of historical data. This could have included years of Department of State cable reporting, open source data including Arab/Kurdish media, and regional history databases to understand how past regional leaders have manipulated resources to effect results — especially using water as a weapon of war. Unfortunately, the USG solely relied on international news coverage to make our faulty prediction on Iraq. Most international news agencies had stopped operating in Iraq because of the high risk to their reporters, after the U.S. military withdrawal.

Whether it is Benghazi, Yemen, Afghanistan, Haiti or Iraq, AI can serve as a critical tool and a stopgap measure when U.S. military intelligence capabilities are lacking on the ground. AI can also fine-tune our command and control by helping us with expeditious and strategic

decision making by compressing the decision-makers' OODA loop. Even with the presence of good intelligence resources, having a supplemental tool like AI to sift through volumes of information to help us make better decisions should become a necessary addition to our toolkit to avert the next conflict or win the next war.

### **ANNOTATED BIBLIOGRAPHY**

1. Adamo, Nasrath, Al Ansari, Nadir. "Mosul Dam Full Story: What if the Dam fails".  
Journal of Earth Sciences and Geotechnical Engineering, vol.6, no. 3, 2016, 245-269 Science Press Ltd, Jan. 2016.

In their journal article in the Journal of Earth Sciences and Geotechnical Engineering, hydrologists, Nasrath Adamo and Nadir Al Ansari analyze Mosul Dam's self-breachability after studying several hydrological models of Mosul Dam failure. They arrived to the conclusion that all models point to Mosul Dam failure which would affect a population of approx. 7 million people and an area of approx. 7200 kilometer squared, with a loss of life to about one million people.

2. Alwash, Azzam. "Towards Sustainable Water Resources Management in Iraq," Iraq Energy Institute, August 30, 2018.

Renowned hydrologist and civil engineer, Azzam Alwash, who runs the Iraq Energy Institute shares the Water schematic of Iraq as listed in his research paper. The U.S. Embassy in Baghdad sought Alwash for advice on Mosul Dam and Fallujah Barrage when ISIS took over. Alwash informally advised the U.S. Embassy's Environment, Science and Tech Officer on the dangers of Mosul Dam breach. Alwash is the main force helping the Iraqi Government rebuild the Marshlands of Iraq.

3. Breaking Defense (2019). Forget the Terminator for Future Army AI: LTG Wesley.  
<https://breakingdefense.com/2018/11/artificial-intelligence-key-to-commanding-future-army-ltg-wesley/> [Accessed 28 Mar. 2019].

In this interview transcript, U.S. Military journal, 'Breaking Defense' shares the views of Lt. Gen. Eric Wesley, director of the U.S. Army's Futures and Concepts Center with regards to Artificial intelligence and its utility to the United States Military. LTG. Wesley said that he was most keen to see AI being used to process terabytes of data that the U.S. Military has to grapple with. He would ideally like to employ AI to better help with U.S. military Command and Control functions, logistical databases, as well as process data from millions of sensors rather than use AI for robotic warfare.

4. Cooper, Helene, "U.S. Launches New Airstrikes on ISIS to Protect Dam in Iraq," New

York Times, September 7 2014, Accessed September 22, 2018,  
<https://www.nytimes.com/2014/09/08/world/middleeast/iraq.html>

In this NY Times article, reporter Helene Cooper talks about U.S. and coalition forces launching a second round of airstrikes to un-grip ISIS's stronghold of the Mosul Dam and protect it from being breached by the extremist group.

5. Costenaro, Dave. "Preparing for Artificial Intelligence." *Becoming Human: Artificial Intelligence Magazine*. January 09, 2018. Accessed March 28, 2019.  
<https://becominghuman.ai/preparing-for-artificial-intelligence-d0b644087537>.

In this Op-ed, Head of Artificial Intelligence R&D at Jane.ai, Dave Costenaro explains the various types of AI that would help replace humans or augment human decision making, namely, machine learning, predictive analytics, natural language processing, and so on.

6. [Dod.defense.gov](http://dod.defense.gov). (2019). National Defense Strategy.  
<https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf> [Accessed 28 Mar. 2019].

This is a summary of the National Defense Strategy, published in 2018, that lists AI as an emerging technology of concern and highlights that the United States invest in it to keep up with our near peer competitors, Russia and China.

7. [Forbes.com](http://forbes.com). (2019). The Key Definitions of Artificial Intelligence (AI) That Explain Its Importance. [online] Available at:  
<https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/> [Accessed 28 Mar. 2019].

This article in the Forbes magazine lists key definitions of AI and explains the importance to a non-specialist audience.

8. Fragile States Index. Fund for Peace.  
<http://www.library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf>.

The Fund for Peace published the Fragile States Index in 2014, where Iraq is among the top 25 most fragile states in the world. This is just to showcase that the U.S. Government was not paying attention to Iraq's stability concerns—which caused the right environment of ISIS to grow.

9. Frisk, Adam. "What Is Project Maven? The Pentagon AI Project Google Employees Want out of." *Global News*. April 05, 2018. Accessed March 28, 2019.  
<https://globalnews.ca/news/4125382/google-pentagon-ai-project-maven/>.

This article describes the U.S. Government's interest in using AI for counter-insurgency and intelligence gathering operations—and how Google employees worked to pull Google out of doing business with the US Government in the AI arena.

10. [Gao.gov](http://gao.gov). (2019). [online] Available at: <https://www.gao.gov/assets/680/677895.pdf>  
[Accessed 28 Mar. 2019].

This report by GAO describes the nuclear smuggling threat in Iraq and what the U.S. Nuclear Safety Administration (NNSA) was doing to support Iraq to combat the nuclear threat. Along with providing equipment to combat nuclear concerns on the borders, a case could be made that sensors and cameras for image recognition combined with AI/machine learning could have helped Iraq secure its borders against bad actors.

11. General Allen's Speech on Hyper war. Interview. Marine Corps University, Futures Lecture, March 15, 2019.

Former NATO Commander in Afghanistan lays out why the United States should invest in AI—specifically natural language processing algorithm development to win the Hyper War against peer competitors and enemies.

12. Majid Alfifi, Parisa Kaghazgaran, and James Caverlee. “Measuring the Impact of ISIS Social Media Strategy,” Department of Computer Science & Engineering Information Sciences Institute. Texas A&M University

Researchers at Texas A&M studied the impact of ISIS’s robust social media strategy. A case could be made that we could have gathered a lot of counter-intelligence by keeping a close eye on their excessive social media usage.

13. NBC News. (2019). Tracing the Rise of ISIS into a Menace of Terror.

<https://www.nbcnews.com/storyline/isis-terror/tracing-rise-isis-menace-terror-n214266> [Accessed 28 Mar. 2019].

This NBC news article shows how long ISIS had been operating in Iraq unbeknownst to the USG including the White House—thus resulting in the biggest intelligence failure.

14. North, Andrew, “Refugees flee Saddam's man-made drought: The waters sustaining the Marsh Arabs' 5,000-year-old lifestyle are being deliberately drained away,” The Independent, December 29, 1993,

<https://www.independent.co.uk/news/world/refugees-flee-saddams-man-made-drought-the-waters-sustaining-the-marsh-arabs-5000-year-old-lifestyle-1469739.html>

Andrew North of ‘The Independent’ wrote of Saddam Hussain using water as a weapon of war against Shiite dissidents in the Iraqi Marshlands in 1993.

15. PBS. "How Saddam's Former Soldiers Are Fueling the Rise of ISIS." Accessed March 28, 2019. <https://www.pbs.org/wgbh/frontline/article/how-saddams-former-soldiers-are-fueling-the-rise-of-isis/>

This PBS documentary highlighted how Saddam Hussain’s former Baath party strengthened and shaped ISIS because of marginalization from PM Maliki’s Shiite-led government in Iraq.

16. Radinsky, Kira. "Using Algorithms to Predict the Next Outbreak." Harvard Business Review. November 06, 2014. Accessed December 22, 2018.

<https://hbr.org/2014/11/using-algorithms-to-predict-the-next-outbreak>.

Kira Radinsky of the Harvard Business Review highlights use of algorithms to predict disease outbreaks. Essentially, predictive analytics/AI could be extrapolated to apply to various fields including intelligence gathering and decision-making for command and control.

17. RadioFreeEurope/Radio Liberty. (2019). IS 'Water War' Dries Marshes in Southern Iraq. <https://www.rferl.org/a/is-water-war-dries-marshes-in-southern-iraq/27098762.html> [Accessed 28 Mar. 2019].

This Radio Free Europe documentary highlights ISIS's role in using water as a weapon of war to dry out the marshes in Southern Iraq—similar to Saddam Hussain.

18. Reuters. "Iraq Insurgents Use Water as Weapon after Seizing Dam." April 11, 2014, Accessed December 21, 2018. <https://www.reuters.com/article/us-iraq-security/iraq-insurgents-use-water-as-weapon-after-seizing-dam-idUSBREA3A0Q020140411>.

A Reuters article highlights how Iraqi insurgents in Al Anbar (Fallujah governorate) wield control of water resources and dams as a powerful weapon to subject Iraqi civilians under their control, while threatening Iraqi national security.

19. Richter, Greg. "Defense Official: Could Be One Year from Defeating ISIS in Iraq." Newsmax. April 13, 2015. Accessed March 28, 2019. <https://www.newsmax.com/Newsfront/Mick-Bednarek-one-year-fight/2015/04/13/id/638237/>.

This article highlights the role of LTG Bednarek and his team at the U.S. embassy in combating ISIS during ISIS's occupation of Fallujah Barrage, Mosul Dam and other critical infrastructure in Iraq.

20. Roggio, B. (2019). "ISIS's advance halted at Samarra". FDD's Long War Journal. [https://www.longwarjournal.org/archives/2014/06/isiss\\_southward\\_adva.php](https://www.longwarjournal.org/archives/2014/06/isiss_southward_adva.php) [Accessed 28 Mar. 2019].

This article in the Long War Journal highlights ISIS advance to Samarra dam, and the threat caused to Iraqi national security and U.S. interests.

21. Simplicable. "What Is Sentiment Analysis?" Accessed March 28, 2019. <https://simplicable.com/new/sentiment-analysis>.

This article defines sentiment analysis and its application.

22. Sinha, S. (2019). Obama's Evolution on ISIS. Nytimes.com. <https://www.nytimes.com/interactive/2015/06/09/world/middleeast/obama-isis-strategy.html> [Accessed 28 Mar. 2019].

In this article in the NY Times, Sinha describes President Obama's intelligence failure in understanding the evolution of ISIS.

23. Spacey, J. (2019). What is Affective Computing? Simplicable.  
<https://simplicable.com/new/affective-computing> [Accessed 28 Mar. 2019].  
This article defines the use of Affective Computing.
24. Taylor Pearson. "The OODA Loop: How to Turn Uncertainty into Opportunity." Taylor Pearson. February 12, 2019. Accessed March 28, 2019.  
<https://taylorpearson.me/ooda-loop/>.  
This article highlights the OODA loop process of decision-making.
25. The Independent. (2019). Mosul Dam could collapse at any minute 'killing 1.5 million people'. <https://www.independent.co.uk/news/world/middle-east/mosul-dam-breach-fail-northern-iraq-isis-kill-million-nuclear-catastrophe-engineers-risk-a7510686.html> [Accessed 28 Mar. 2019].  
This article in The Independent highlights the vulnerability and impact of the breach of Mosul Dam.
26. United States Army Corps of Engineers. "Huntsville Center's Braun Works to save Mosul Dam." [www.army.mil](http://www.army.mil). Accessed March 28, 2019.  
[https://www.army.mil/article/188054/huntsville\\_centers\\_braun\\_works\\_to\\_save\\_mosul\\_dam](https://www.army.mil/article/188054/huntsville_centers_braun_works_to_save_mosul_dam).  
This is a US Army Corps of Engineers report on Mosul Dam and its extreme susceptibility to self-breaching if not grouted daily. The report also highlights the loss of life and property in the tune of billions of dollars, if Mosul Dam is not handled carefully.
27. Work, Robert O., "Establishment of an Algorithmic Warfare Cross-Functional Team (Project Maven)" (PDF). Accessed December 21, 2018.  
<https://www.c4isrnet.com/it-networks/2018/07/27/targeting-the-future-of-the-dods-controversial-project-maven-initiative/>  
Robert Work highlights the Algorithmic Warfare Cross-functional team and Project Maven's work in using AI algorithms to become more efficient as a military in command and control, counterintelligence and counterinsurgency. Google's controversial role in fine-tuning the algorithm behind Project Maven is also highlighted.
28. YouTube. (2019). Natural Language Processing (NLP) Tutorial | Data Science Tutorial | Simplilearn. [Accessed 28 Mar. 2019]. <https://www.youtube.com/watch?v=6WpnmkYys>  
This YouTube video explains AI's use of Natural Language Processing and its value in decision-making.

## BIBLIOGRAPHY

1. Adamo, Nasrath, Al Ansari, Nadir. "Mosul Dam Full Story: What if the Dam fails". Journal of Earth Sciences and Geotechnical Engineering, vol.6, no. 3, 2016, 245-269 Science Press Ltd, Jan. 2016.
2. Alwash, Azzam. "Towards Sustainable Water Resources Management in Iraq," Iraq Energy Institute, August 30, 2018.
3. Ashkenas, Jeremy, Archie Tse, Derek Watkins, and Karen Yourish. "A Rogue State Along Two Rivers." The New York Times. July 03, 2014. Accessed March 28, 2019. <https://www.nytimes.com/interactive/2014/07/03/world/middleeast/syria-iraq-isis-rogue-state-along-two-rivers.html>.
4. Breaking Defense (2019). Forget the Terminator for Future Army AI: LTG Wesley. <https://breakingdefense.com/2018/11/artificial-intelligence-key-to-commanding-future-army-ltg-wesley/> [Accessed 28 Mar. 2019].
5. Cooper, Helene, "U.S. Launches New Airstrikes on ISIS to Protect Dam in Iraq," New York Times, September 7 2014, Accessed September 22, 2018, <https://www.nytimes.com/2014/09/08/world/middleeast/iraq.html>
6. Costenaro, Dave. "Preparing for Artificial Intelligence." Becoming Human: Artificial Intelligence Magazine. January 09, 2018. Accessed March 28, 2019. <https://becominghuman.ai/preparing-for-artificial-intelligence-d0b644087537>.
7. Defend America. "Mosul Dam Repairs Benefit Tigris Basins" Archived 2007-11-01 at The Wayback Machine., defendamerica.mil, September 2005
8. Dod.defense.gov. (2019). National Defense Strategy. <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf> [Accessed 28 Mar. 2019].
9. Forbes.com. (2019). The Key Definitions of Artificial Intelligence (AI) That Explain Its Importance. [online] Available at: <https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/> [Accessed 28 Mar. 2019].
10. Fragile States Index. Fund for Peace. <http://www.library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf>.
11. Frisk, Adam. "What Is Project Maven? The Pentagon AI Project Google Employees Want out of." Global News. April 05, 2018. Accessed March 28, 2019. <https://globalnews.ca/news/4125382/google-pentagon-ai-project-maven/>.
12. Gao.gov. (2019). [online] Available at: <https://www.gao.gov/assets/680/677895.pdf> [Accessed 28 Mar. 2019].
13. General Allen's Speech on Hyper war. Interview. Marine Corps University, Futures Lecture, March 15, 2019.
14. Graphic News. "IRAQ: Mosul Dam Warning Infographic." Accessed March 28, 2019. <https://www.graphicnews.com/en/pages/33991/IRAQ-Mosul-Dam-warning>.
15. Investopedia.com. Accessed March 28, 2019.

- <https://www.investopedia.com/articles/company-insights/082316/worlds-top-10-oil-exporters.asp>.
16. Jamail, Dahr. "Western Oil Firms Remain as US Exits Iraq." Al Jazeera. January 07, 2012. Accessed March 28, 2019. <https://www.aljazeera.com/indepth/features/2011/12/2011122813134071641.html>
  17. Latitude.to, Maps. "GPS Coordinates of Fallujah Barrage, Iraq. Latitude: 33.3052 Longitude: 43.7702." Latitude.to, Maps, Geolocated Articles, Latitude Longitude Coordinate Conversion. Accessed December 21, 2018. <https://latitude.to/articles-by-country/iq/iraq/70118/fallujah-barrage>.
  18. Majid Alfifi, Parisa Kaghazgaran, and James Caverlee. "Measuring the Impact of ISIS Social Media Strategy," Department of Computer Science & Engineering Information Sciences Institute. Texas A&M University
  19. Mishra, Vishal. "Relevance as a Service (RaaS)- Insights." Right Relevance. April 03, 2017. Accessed March 28, 2019. <http://info.rightrelevance.com/insights/>.
  20. NBC News. (2019). Tracing the Rise of ISIS into a Menace of Terror. <https://www.nbcnews.com/storyline/isis-terror/tracing-rise-isis-menace-terror-n214266> [Accessed 28 Mar. 2019].
  21. North, Andrew, "Refugees flee Saddam's man-made drought: The waters sustaining the Marsh Arabs' 5,000-year-old lifestyle are being deliberately drained away," The Independent, December 29, 1993, <https://www.independent.co.uk/news/world/refugees-flee-saddams-man-made-drought-the-waters-sustaining-the-marsh-arabs-5000-year-old-lifestyle-1469739.html>
  22. OPEC. "OPEC: Iraq". [www.opec.org](http://www.opec.org). Retrieved 2018-03-21.
  23. PBS. "How Saddam's Former Soldiers Are Fueling the Rise of ISIS." Accessed March 28, 2019. <https://www.pbs.org/wgbh/frontline/article/how-saddams-former-soldiers-are-fueling-the-rise-of-isis/>
  24. PBS. "Iraq's Shiite Militias: The Double-Edged Sword Against ISIS." Accessed March 28, 2019.
  25. Quotes.net. "Sun Tzu Quotes" Quotes.net. STANDS4 LLC, 2018. Web. December 21, 2018, <https://www.quotes.net/quote/50870>
  26. Radinsky, Kira. "Using Algorithms to Predict the Next Outbreak." Harvard Business Review. November 06, 2014. Accessed December 22, 2018. <https://hbr.org/2014/11/using-algorithms-to-predict-the-next-outbreak>.
  27. RadioFreeEurope/Radio Liberty. (2019). IS 'Water War' Dries Marshes in Southern Iraq. <https://www.rferl.org/a/is-water-war-dries-marshes-in-southern-iraq/27098762.html> [Accessed 28 Mar. 2019].
  28. Reuters. "Iraq Insurgents Use Water as Weapon after Seizing Dam." April 11, 2014, Accessed December 21, 2018. <https://www.reuters.com/article/us-iraq-security/iraq-insurgents-use-water-as-weapon-after-seizing-dam-idUSBREA3A0Q020140411>.
  29. Richter, Greg. "Defense Official: Could Be One Year from Defeating ISIS in Iraq." Newsmax. April 13, 2015. Accessed March 28, 2019.

- <https://www.newsmax.com/Newsfront/Mick-Bednarek-one-year-fight/2015/04/13/id/638237/>.
30. Roggio, B. (2019). "ISIS's advance halted at Samarra". FDD's Long War Journal. [https://www.longwarjournal.org/archives/2014/06/isiss\\_southward\\_adva.php](https://www.longwarjournal.org/archives/2014/06/isiss_southward_adva.php) [Accessed 28 Mar. 2019].
  31. Simplicable. "What Is Sentiment Analysis?" Accessed March 28, 2019. <https://simplicable.com/new/sentiment-analysis>.
  32. Sinha, S. (2019). Obama's Evolution on ISIS. Nytimes.com. <https://www.nytimes.com/interactive/2015/06/09/world/middleeast/obama-isis-strategy.html> [Accessed 28 Mar. 2019].
  33. Spacey, J. (2019). What is Affective Computing? Simplicable. <https://simplicable.com/new/affective-computing> [Accessed 28 Mar. 2019].
  34. Spacey, J. (2019). What is Sentiment Analysis? [online] Simplicable. Available at: <https://simplicable.com/new/sentiment-analysis> [Accessed 28 Mar. 2019].
  35. Taylor Pearson. "The OODA Loop: How to Turn Uncertainty into Opportunity." Taylor Pearson. February 12, 2019. Accessed March 28, 2019. <https://taylorpearson.me/ooda-loop/>.
  36. Tharp, Mike, and McClatchy Newspapers. "Once World's Bread Basket, Iraq Now a Farming Basket Case." Mcclatchydc. July 19, 2009. Accessed March 28, 2019. <https://www.mcclatchydc.com/news/nation-world/world/article24546748.html>.
  37. The Independent. (2019). Mosul Dam could collapse at any minute 'killing 1.5 million people'. <https://www.independent.co.uk/news/world/middle-east/mosul-dam-breach-fail-northern-iraq-isis-kill-million-nuclear-catastrophe-engineers-risk-a7510686.html> [Accessed 28 Mar. 2019].
  38. United States Army Corps of Engineers. "Huntsville Center's Braun Works to save Mosul Dam." www.army.mil. Accessed March 28, 2019. [https://www.army.mil/article/188054/huntsville\\_centers\\_braun\\_works\\_to\\_save\\_mosul\\_dam](https://www.army.mil/article/188054/huntsville_centers_braun_works_to_save_mosul_dam).
  39. United States Embassy Baghdad cable reporting from January 2014 to September 2014, Department of State archives
  40. USGS. "USGS Report on Iraq Water Resources". <https://pubs.usgs.gov/wsp/1330g/report.pdf>.
  41. Vidal, John, "Water supply key to outcome of conflicts in Iraq and Syria, experts warn", The Guardian, July 2, 2014, <https://www.theguardian.com/environment/2014/jul/02/water-key-conflict-Iraq-Syria-ISIS>
  42. Work, Robert O., "Establishment of an Algorithmic Warfare Cross-Functional Team (Project Maven)" (PDF). Accessed December 21, 2018. <https://www.c4isrnet.com/it-networks/2018/07/27/targeting-the-future-of-the-dods-controversial-project-maven-initiative/>
  43. YouTube. (2019). Natural Language Processing (NLP) Tutorial | Data Science Tutorial | Simplilearn. [Accessed 28 Mar. 2019]. <https://www.youtube.com/watch?v=6WpnxmmkYys>

## ENDNOTES

- <sup>1</sup> Sun Tzu Art of War, Publisher Vij Books India Pvt Ltd, 2012, Page 31
- <sup>2</sup> Chulov, Martin, Fazel Hawramy, and Spencer Ackerman. "Iraq Army Capitulates to Isis Militants in Four Cities." The Guardian. June 12, 2014. Accessed April 20, 2019. <https://www.theguardian.com/world/2014/jun/11/mosul-isis-gunmen-middle-east-states>.
- <sup>3</sup> Dahl, Erik J. 2018. "Not Your Father's Intelligence Failure: Why the Intelligence Community Failed to Anticipate the Rise of ISIS." In the Future of ISIS: Regional and International Implications, eds. Feisal al-Istrabadi and Sumit Ganguly. Washington, DC: The Brookings Institution, 41-66
- <sup>4</sup> "3 Times Obama Administration Was Warned About ISIS Threat." ABC News. September 29, 2014. Accessed April 20, 2019. <https://abcnews.go.com/Politics/times-obama-administration-warned-isis-threat/story?id=25843517>.
- <sup>5</sup> Hussein, Ahmed. "GCC Condemns Recent Surge of Violence in Iraq." Iraq News, the Latest Iraq News by Iraqi News. November 30, -0001. Accessed April 26, 2019. <https://www.iraqnews.com/baghdad-politics/gcc-condemns-recent-surge-of-violence-in-iraq/>.
- <sup>6</sup> News, Jeddah: Arab. "82% of Terror Victims Are in 5 Muslim Countries." Arab News. November 25, 2014. Accessed April 20, 2019. <http://www.arabnews.com/saudi-arabia/news/665546>.
- <sup>7</sup> Dod.defense.gov. (2019). [online] Available at: <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf> [Accessed 28 Mar. 2019].
- <sup>8</sup> <https://emerj.com/ai-glossary-terms/what-is-artificial-intelligence-an-informed-definition/>
- <sup>9</sup> Forbes.com. (2019). *The Key Definitions of Artificial Intelligence (AI) That Explain Its Importance*. [online] Available at: <https://www.forbes.com/sites/bernardmarr/2018/02/14/the-key-definitions-of-artificial-intelligence-ai-that-explain-its-importance/> [Accessed 28 Mar. 2019].
- <sup>10</sup> "What Is AI (artificial Intelligence)? - Definition from WhatIs.com." SearchEnterpriseAI. Accessed April 26, 2019. <https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence>.
- <sup>11</sup> R., S. (2019). *Forget the Terminator for Future Army AI: LTG Wesley*. [online] Breaking Defense. Available at: <https://breakingdefense.com/2018/11/artificial-intelligence-key-to-commanding-future-army-ltg-wesley/> [Accessed 28 Mar. 2019].
- <sup>12</sup> Gartner IT Glossary, <https://www.gartner.com/it-glossary/big-data/> [Accessed April 16, 2019]
- <sup>13</sup> Summary of the 2018 Department of Defense Artificial Intelligence Strategy,
- <sup>14</sup> Costenaro, Dave. "Preparing for Artificial Intelligence." *Becoming Human: Artificial Intelligence Magazine*. January 09, 2018. Accessed March 28, 2019. <https://becominghuman.ai/preparing-for-artificial-intelligence-d0b644087537>.
- <sup>15</sup> YouTube. (2019). *Natural Language Processing (NLP) Tutorial | Data Science Tutorial | Simplilearn*. [online] Available at: <https://www.youtube.com/watch?v=6WpnxmmkYys> [Accessed 28 Mar. 2019].
- <sup>16</sup> Ibid
- <sup>17</sup> General Allen's Speech on Hyperwar. Interview. *Marine Corps University, Futures Lecture*, March 15, 2019.
- <sup>18</sup> "What Is Sentiment Analysis?" Simplicable. Accessed March 28, 2019. <https://simplicable.com/new/sentiment-analysis>.
- <sup>19</sup> Radinsky, Kira. "Using Algorithms to Predict the Next Outbreak." *Harvard Business Review*. November 06, 2014. Accessed December 22, 2018. <https://hbr.org/2014/11/using-algorithms-to-predict-the-next-outbreak>.
- <sup>20</sup> YouTube. (2019). *Natural Language Processing (NLP) Tutorial | Data Science Tutorial | Simplilearn*. [online] Available at: <https://www.youtube.com/watch?v=6WpnxmmkYys> [Accessed 28 Mar. 2019].
- <sup>21</sup> Spacey, J. (2019). *What is Affective Computing?* [online] Simplicable. Available at: <https://simplicable.com/new/affective-computing> [Accessed 28 Mar. 2019].
- <sup>22</sup> Spacey, J. (2019). *What is Sentiment Analysis?* [online] Simplicable. Available at: <https://simplicable.com/new/sentiment-analysis> [Accessed 28 Mar. 2019].
- <sup>23</sup> "Iraq Insurgents Use Water as Weapon after Seizing Dam." Reuters, April 11, 2014, Accessed December 21, 2018. <https://www.reuters.com/article/us-iraq-security/iraq-insurgents-use-water-as-weapon-after-seizing-dam-idUSBREA3A0Q020140411>.
- <sup>24</sup> "Iraqi Kurdish Oil Exports Halt in December Due to Fire, Pipeline." Reuters. November 14, 2013. Accessed April 26, 2019. <https://www.reuters.com/article/kurdistan-oil-idUSL5N0IZ4IC20131114>.
- <sup>25</sup> Threat Reduction / Nunn-Lugar | Arms Control Association. Accessed April 26, 2019. <https://www.armscontrol.org/taxonomy/term/28?page=2>.

- 
- <sup>26</sup> Press, Associated. "US and Iraqi Officials: ISIS Is Working to Produce Chemical Weapons." Business Insider. November 19, 2015. Accessed April 26, 2019. <https://www.businessinsider.com/us-and-iraqi-officials-isis-is-working-to-produce-chemical-weapons-2015-11>.
- <sup>27</sup> Ashkenas, Jeremy, Archie Tse, Derek Watkins, and Karen Yourish. "A Rogue State Along Two Rivers." The New York Times. July 03, 2014. Accessed March 28, 2019. <https://www.nytimes.com/interactive/2014/07/03/world/middleeast/syria-iraq-isis-rogue-state-along-two-rivers.html>.
- <sup>28</sup> NBC News. (2019). *Tracing the Rise of ISIS into a Menace of Terror*. [online] Available at: <https://www.nbcnews.com/storyline/isis-terror/tracing-rise-isis-menace-terror-n214266> [Accessed 28 Mar. 2019].
- <sup>29</sup> Sinha, S. (2019). *Obama's Evolution on ISIS*. [online] Nytimes.com. Available at: <https://www.nytimes.com/interactive/2015/06/09/world/middleeast/obama-isis-strategy.html> [Accessed 28 Mar. 2019].
- <sup>30</sup> NBC News. (2019). *Tracing the Rise of ISIS into a Menace of Terror*. [online] Available at: <https://www.nbcnews.com/storyline/isis-terror/tracing-rise-isis-menace-terror-n214266> [Accessed 28 Mar. 2019].
- <sup>31</sup> Ibid
- <sup>32</sup> Majid Alfifi, Parisa Kaghazgaran, and James Caverlee. "Measuring the Impact of ISIS Social Media Strategy," Department of Computer Science & Engineering Information Sciences Institute. Texas A&M University
- <sup>33</sup> North, Andrew, "Refugees flee Saddam's man-made drought: The waters sustaining the Marsh Arabs' 5,000-year-old lifestyle are being deliberately drained away", The Independent, December 29, 1993, <https://www.independent.co.uk/news/world/refugees-flee-saddams-man-made-drought-the-waters-sustaining-the-marsh-arabs-5000-year-old-lifestyle-1469739.html>
- <sup>34</sup> Gao.gov. (2019). [online] Available at: <https://www.gao.gov/assets/680/677895.pdf> [Accessed 28 Mar. 2019].
- <sup>35</sup> Taylor, Pearson. "The OODA Loop: How to Turn Uncertainty into Opportunity." Taylor Pearson. February 12, 2019. Accessed March 28, 2019. <https://taylorpearson.me/ooda-loop/>.
- <sup>36</sup> Richter, Greg. "Defense Official: Could Be One Year from Defeating ISIS in Iraq." Newsmax. April 13, 2015. Accessed March 28, 2019. <https://www.newsmax.com/Newsfront/Mick-Bednarek-one-year-fight/2015/04/13/id/638237/>.
- <sup>37</sup> NBC News. (2019). *Tracing the Rise of ISIS into a Menace of Terror*. [online] Available at: <https://www.nbcnews.com/storyline/isis-terror/tracing-rise-isis-menace-terror-n214266> [Accessed 28 Mar. 2019].
- <sup>38</sup> *Fragile States Index*. Fund for Peace. <http://www.library.fundforpeace.org/library/cfsir1423-fragilestatesindex2014-06d.pdf>.
- <sup>39</sup> Ibid.
- <sup>40</sup> Mishra, Vishal. "Relevance as a Service (RaaS)- Insights." Right Relevance. April 03, 2017. Accessed March 28, 2019. <http://info.rightrelevance.com/insights/>.
- <sup>41</sup> "GPS Coordinates of Fallujah Barrage, Iraq. Latitude: 33.3052 Longitude: 43.7702." Latitude.to, Maps, Geolocated Articles, Latitude Longitude Coordinate Conversion. Accessed December 21, 2018. <https://latitude.to/articles-by-country/iq/iraq/70118/fallujah-barrage>.
- <sup>42</sup> Tharp, Mike, and McClatchy Newspapers. "Once World's Bread Basket, Iraq Now a Farming Basket Case." McClatchydc. July 19, 2009. Accessed March 28, 2019. <https://www.mcclatchydc.com/news/nation-world/world/article24546748.html>.
- <sup>43</sup> RadioFreeEurope/RadioLiberty. (2019). *IS 'Water War' Dries Marshes in Southern Iraq*. [online] Available at: <https://www.rferl.org/a/is-water-war-dries-marshes-in-southern-iraq/27098762.html> [Accessed 28 Mar. 2019].
- <sup>44</sup> Jamail, Dahr. "Western Oil Firms Remain as US Exits Iraq." | Al Jazeera. January 07, 2012. Accessed March 28, 2019. <https://www.aljazeera.com/indepth/features/2011/12/2011122813134071641.html>.
- <sup>45</sup> "Iraq Insurgents Use Water as Weapon after Seizing Dam." Reuters, April 11, 2014, Accessed December 21, 2018. <https://www.reuters.com/article/us-iraq-security/iraq-insurgents-use-water-as-weapon-after-seizing-dam-idUSBREA3A0Q020140411>.
- <sup>46</sup> Jamail, Dahr. "Western Oil Firms Remain as US Exits Iraq." | Al Jazeera. January 07, 2012. Accessed March 28, 2019. <https://www.aljazeera.com/indepth/features/2011/12/2011122813134071641.html>.
- <sup>47</sup> <https://www.investopedia.com/articles/company-insights/082316/worlds-top-10-oil-exporters.asp>
- <sup>48</sup> *USGS Report on Iraq Water Resources*. <https://pubs.usgs.gov/wsp/1330g/report.pdf>.
- <sup>49</sup> Taylor Pearson. "The OODA Loop: How to Turn Uncertainty into Opportunity." Taylor Pearson. February 12, 2019. Accessed March 28, 2019. <https://taylorpearson.me/ooda-loop/>.
- <sup>50</sup> Frisk, Adam. "What Is Project Maven? The Pentagon AI Project Google Employees Want out of." Global News. April 05, 2018. Accessed March 28, 2019. <https://globalnews.ca/news/4125382/google-pentagon-ai-project-maven/>.
- <sup>51</sup> "OPEC : Iraq". [www.opec.org](http://www.opec.org). Retrieved 2018-03-21.

- 
- <sup>52</sup> Alwash, Azzam. "Towards Sustainable Water Resources Management in Iraq," Iraq Energy Institute, August 30, 2018.
- <sup>53</sup> "How Saddam's Former Soldiers Are Fuelling the Rise of ISIS." PBS. Accessed March 28, 2019. <https://www.pbs.org/wgbh/frontline/article/how-saddams-former-soldiers-are-fueling-the-rise-of-isis/>
- <sup>54</sup> Roggio, B. (2019). *ISIS's advance halted at Samarra | FDD's Long War Journal*. [online] FDD's Long War Journal. Available at: [https://www.longwarjournal.org/archives/2014/06/isiss\\_southward\\_adva.php](https://www.longwarjournal.org/archives/2014/06/isiss_southward_adva.php) [Accessed 28 Mar. 2019].
- <sup>55</sup> Roggio, B. (2019). *ISIS's advance halted at Samarra | FDD's Long War Journal*. [online] FDD's Long War Journal. Available at: [https://www.longwarjournal.org/archives/2014/06/isiss\\_southward\\_adva.php](https://www.longwarjournal.org/archives/2014/06/isiss_southward_adva.php) [Accessed 28 Mar. 2019].
- <sup>56</sup> Cooper, Helene, "U.S. Launches New Airstrikes on ISIS to Protect Dam in Iraq," New York Times, September 7 2014, Accessed September 22, 2018, <https://www.nytimes.com/2014/09/08/world/middleeast/iraq.html>
- <sup>57</sup> Vidal, John, "Water supply key to outcome of conflicts in Iraq and Syria, experts warn", The Guardian, July 2, 2014, <https://www.theguardian.com/environment/2014/jul/02/water-key-conflict-iraq-syria-isis>
- <sup>58</sup> "Iraq's Shiite Militias: The Double-Edged Sword Against ISIS." PBS. Accessed March 28, 2019.
- <sup>59</sup> Adamo, Nasrath, Al Ansari, Nadir. "Mosul Dam Full Story: What if the Dam fails". Journal of Earth Sciences and Geotechnical Engineering, vol.6, no. 3, 2016, 245-269 Science Press Ltd, Jan. 2016.
- <sup>60</sup>
- <sup>61</sup> The Independent. (2019). *Mosul Dam could collapse at any minute 'killing 1.5 million people'*. [online] Available at: <https://www.independent.co.uk/news/world/middle-east/mosul-dam-breach-fail-northern-iraq-isis-kill-million-nuclear-catastrophe-engineers-risk-a7510686.html> [Accessed 28 Mar. 2019].
- <sup>62</sup> *Id.*
- <sup>63</sup> "Huntsville Center's Braun Works to save Mosul Dam." Wwww.army.mil. Accessed March 28, 2019. [https://www.army.mil/article/188054/huntsville\\_centers\\_braun\\_works\\_to\\_save\\_mosul\\_dam](https://www.army.mil/article/188054/huntsville_centers_braun_works_to_save_mosul_dam).
- <sup>64</sup> See Embassy Baghdad cable reporting from June 2014 to September 2014, Department of State archives
- <sup>65</sup> "Mosul Dam Repairs Benefit Tigris Basins" Archived 2007-11-01 at the Wayback Machine., defendamerica.mil, September 2005
- <sup>66</sup> Work, Robert O., "Establishment of an Algorithmic Warfare Cross-Functional Team (Project Maven)" (PDF). Accessed December 21, 2018.
- <sup>67</sup> Graphic News. "IRAQ: Mosul Dam Warning Infographic.". Accessed March 28, 2019. <https://www.graphicnews.com/en/pages/33991/IRAQ-Mosul-Dam-warning>.