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<p>THE GAME OF DRONES: A COMPARATIVE STUDY ON THE USE OF UNINHABITED AIRCRAFT SYSTEMS</p> <p><u>Abstract:</u></p> <p>Uninhabited Aircraft Systems (UAS), as a relatively novel technology, was always seen as a tool available and utilized only by rich and developed states. But thanks to globalizations and the fast proliferation of commercially available drones, this platform has already been used by smaller states and also non-state groups, giving them possibilities never seen before. Yet, there is little research on how and why these new actors use UAS to claim their cause. The research question to guide this thesis is <i>how and why do non-state armed groups differ from states when using Uninhabited Aircraft Systems in their military operations?</i> The thesis uses a demand- and supply-side theory, adapted for the proliferation of drones to help answer that question. This theory is tested in a multiple case study involving the United States as a state and the Houthis as a non-state group during the Yemeni crisis, from 2011 to 2022. Through a structured, focused comparison between the cases, indicators from the demand- and supply-side models were used to understand the differences in drone use between different actors. The main findings are that states and non-state armed groups differ in their use of UAS mainly because they have different boundaries (legal and technological), but also for the symbol and status that this platform carries. Finally, it was seen that the theory is not only able to clarify the trends on proliferation, but also the why actors use UAS, with few remarks, but with a need to test it further.</p> <p><u>Key words:</u></p> <p>Uninhabited aircraft systems, states, non-state armed groups, air power, proliferation, demand- and supply side, Yemeni crisis, US, Houthis.</p>		

TABLE OF CONTENTS:

1 INTRODUCTION.....	3
1.1 BACKGROUND	3
1.2 RESEARCH PROBLEM.....	4
1.3 AIM.....	5
1.4 RESEARCH QUESTION.....	6
1.5 SCOPE.....	6
1.6 TERMS AND DEFINITIONS.....	7
1.7 DISPOSITION.....	8
2 RESEARCH OVERVIEW	10
2.1 ORIGINS OF UAS USE AND OTHER STUDIES	10
2.2 UAS PROLIFERATION STUDIES.....	12
2.3 RESEARCH CONTRIBUTION.....	13
3 THEORY.....	14
3.1 DEMAND AND SUPPLY-SIDE THEORY APPLIED FOR UAS PROLIFERATION	14
3.2 THEORY DISCUSSION.....	18
4 RESEARCH DESIGN	20
4.1 SCIENTIFIC THEORETICAL STARTING POINT	20
4.2 CHOICE OF METHOD	20
4.3 CASE SELECTION	22
4.4 OPERATIONALIZATION	23
4.5 MATERIAL.....	27
5 ANALYSIS.....	29
5.1 BACKGROUND - THE YEMENI CRISIS (2011 – 2022)	29
5.2 THE US USE OF UAS	30
5.3 THE HOUTHIS USE OF UAS	35
5.4 SUMMARY OF THE RESULTS.....	41
5.5 ALTERNATIVE EXPLANATIONS	45
6 CONCLUSION.....	47
6.1 PROLIFERATION THEORY AND THE USE OF UAS	47
6.2 REFLECTION.....	48
6.3 FUTURE RESEARCH.....	50
REFERENCES.....	51

LIST OF TABLES:

Table 1: Conditions of the dependent variable	24
Table 2: Indicators of the independent variables	26
Table 3: Independent variables summary model	27
Table 4: Independent variables summary	44
Table 5: Comparative summary.....	45

LIST OF FIGURES:

Figure 1: Yemen’s front lines (Robinson, 2022).	30
Figure 2: US strikes in Yemen compared (‘The War in Yemen’, 2022).	35

1 INTRODUCTION

1.1 BACKGROUND

Airpower has traditionally been a tool wielded by rich industrialized states. However, the last decade has shown that smaller entities, militias, and organizations, defined here as non-state armed groups (NSAG), have evolved and expanded their operations to the air space by their use of Uninhabited Aircraft System (UAS-drones), with the potential to deploy explosives on targets (Haugstvedt and Jacobsen, 2020, pp.26–40).

There are enough examples that prove the versatility and efficacy of UAS, and what is, or at least has been, the state's weapon of choice in the war on terror is now available on the commercial market to non-state actors, turning drones into yet another weapon of terror (Fowler, 2014). While there are still vast differences between the UAS operated by the United States, Russia, and other major powers and those used by NSAGs, the practical difference might be shrinking, making them a challenge for ground forces and those charged with protecting military installations and civilian infrastructures in conflict and non-conflict zones (Haugstvedt and Jacobsen, 2020).

For NSAGs committed to projecting power by air, UAS offer an accessible alternative compared to piloting, maintaining, and basing conventional aircrafts. The absence of an onboard crew means those groups risk fewer human resources when deploying these systems. This aspect of UAS is especially appealing to groups who compete against larger and more capable government forces and must carefully husband their current and future recruits (Haugstvedt and Jacobsen, 2020). The use starts from small and portable hobbyist drones to fixed-wing longer range aircraft, equipped with sophisticated surveillance systems and payloads for guided missiles. Yet technological and political developments are rapidly blurring this distinction and may allow many of those groups to obtain drones capable of strategic effects (Doctor and Walsh, 2021). However, this effectiveness is not simple to master.

Nevertheless, the Islamic State of Iraq and Syria (ISIS) and Hezbollah are examples of non-state armed groups that have already used low-cost, commercially sourced drones to damage regular defense forces. Today, groups like the Houthis, sponsored mainly by Iran, have the capabilities to hit targets at great distances, projecting their power through drones in Saudi Arabia and the United Arab Emirates, mitigating the risks for insurgent operators. Such a technological tool was not previously available to similar groups.

In this regard, while other research has provided insights into state and NSAGs' UAS operations, no scholarly works have provided broad and systematically empirical evidence of the power of this kind of system when employed by non-state groups, in comparison with a state. Additionally, mitigating the risks posed by such drone use is complicated by the lack of agreement among experts and practitioners regarding the nature of the threat posed by militant drone programs (Doctor and Walsh, 2021).

1.2 RESEARCH PROBLEM

Throughout history, whenever a new military technology has emerged, adversaries have faced two basic choices: capitulate or innovate to overcome the other side's advantage. There is no reason to expect that drones it will be any different. The more they are used for combat by states, the more likely it will be that non-state groups act in the same way. UAS also raise important questions about the role of innovative technologies in the development of airpower theories. This much, however, is already clear: new weapons are often developed before game-changing ideas about how to use them (Zegart, 2020).

New UAS technology will be like every other in initiating a new evolution in military platforms and doctrine. The innovations arising from this new way of operating on the battlefield not only raise the question of how people fight, they emphasize also who does it at the most fundamental level. In this sense, the agent of war is transformed, not only its capabilities, which implies significant changes in how the use of airpower is seen and used.

Some research argues that while UAS is indeed fundamentally different from traditional airpower, owing to changes in persistence, lethality, and relative risk, degrading organizational capabilities and imposing costs, it complicates the equally critical tasks of signaling clear and credible threats and assurances (Grieco and Hutto, 2021). It is argued also that while drones can serve as a force multiplier for non-state groups, these systems do not embody a transformation in modern insurgent warfare. Instead, drone use is consistent with a militant group's relative capabilities and broader strategic objectives. Consequently, these groups are more likely to employ drones primarily for theater and tactical military purposes (Doctor and Walsh, 2021). Nevertheless, drones provide militants with an affordable and novel means of bringing force to bear against opponents as the cost and complexity of this technology decrease while range and lethality increases.

Recent research raises questions stating that UAS contribute to shaping the future 4th generation warfare (Haugstvedt and Jacobsen, 2020). This particular technology could enhance non-state groups' use of drones for strategic ends, allowing them to coordinate strikes using many small, inexpensive, and expendable drones to create physical and psychological effects (Bunker, 2015). The urban battlespace also lends itself to drone use. Many experts, including US defense leaders, expect the frequency of urban warfare to increase worldwide (Doctor and Walsh, 2021).

Finally, it is important to emphasize that religious extremists and ethno-nationalist/separatist groups are often willing to suffer extreme costs to achieve their goals, as long as there is some hope of success. These groups choose a strategy of terror because it is best suited to achieving their goals. Furthermore, the persistence and lethality of drones, which makes them particularly effective at imposing sustained punitive costs, contributes to those goals (Grieco and Hutto, 2021). In this regard, I argue that those calculations, based on interests and willingness, create opportunities for atypical ways to use UAS. Therefore, NSAGs find themselves in different environments with distinct possibilities, rules, and needs, compared to states, which leads them to think and act differently.

1.3 AIM

The aim of this study is to investigate how and why regular states and NSAGs differ when using UAS, as the latter are recently more and more compelled to use this tool to achieve their goals. Additionally, NSAG's actions and behaviors make them willing to transcend what is written in actual theories regarding the use of air power, in more ways than states. In this way, this thesis aims to explore how this phenomenon should provide insights, contributing to a better knowledge that can strengthen societies' preparedness for, and resilience to, this new threat from the air.

Since non-state use of UAS is relatively new and developing quickly, scholarly literature devoted to the subject is currently limited (Haugstvedt, 2020, p.92). Thereby, when comparing the use in such different cases, this research study aims to reduce this limitation, as the apparently "success" when using that system may offer insights about how not only future insurgencies may conduct warfare, but states also.

In this regard, the Yemeni Crisis, that began with the 2011 revolution against President Ali Abdullah Saleh, is a recent context that provides empirical material of innovative uses of

UAS by a state and a NSAG. On the state side, the United States is fighting its global war on terror campaign, primarily against al Qaeda (AQ). On the non-states side, the Houthis, a self-declared national resistance, claim to defend all Yemenis from outside aggression and influences. Both sides have extensively used drones to achieve their goals, making such a context suitable for a comparison of their use. These case studies provide important insights that can be also used for theory testing and building (George and Bennett, 2005, p.77).

1.4 RESEARCH QUESTION

How and why do non-state armed groups differ from states when using Uninhabited Aircraft Systems (UAS) in their military operations?

Considering what was found in previous research, this study directs the investigation to fill a gap in existing knowledge associated to the use of UAS by NSAGs. Thus, the purpose of this qualitative research is to explore which new factors can emerge from this kind of use when comparing the components that are associated to the use of UAS by states. By contrasting the possible interests that are associated to the use of this technology by both sides, I contribute to the theory by researching evolution in the use of airpower, additionally finding possibilities for development of new policies, doctrines and tactics. Also, as this technology becomes even more accessible and affordable, its potential impact is something essential to be considered by policy makers, for both international security and military operations.

1.5 SCOPE

This qualitative, comparative, multiple case study will be conducted through data collection and text analysis, comparing cases with a deductive approach, with the main focus on theory-testing.

The context chosen for the study is limited to the Yemeni crisis, from 2011 to 2022, in which both actors used UAS in an extensive way. This analysis focus on UAS operations conducted by the Houthis on the non-state side, and by the US, on the state side. The Houthis are studied because they are especially prominent among the few NSAGs known to have used drones against their opponents. Along with the ISIS, they share the highest incidence in drone use from 2016 in the Middle East. Furthermore, this organization is the most recent UAS user and applies it in a wide range of missions. The choice of US was made mostly because it is a more experienced state in the use of UAS, with a more developed doctrine and types of

platforms, which can deliver a wider palette of uses. The choice of same context when studying both actors was intentional, as it offers methodological advantages for comparison, as will be seen in later chapters.

It's important to mention that the study focuses on the use of airpower, specifically UAS, in the context. Other military, economic, and political instruments of power are not prioritized, despite the fact that they are also important factors. In addition, in what concerns the range of what is considered “UAS use” in this study, it is delimited to the actor’s direct responsibility and within military (or military-like) purposes, at any aimed level of employment (tactical, operational or strategical).

In terms of theory, this study will derive insights from the “supply-demand” logic of classical economic theory, that were adopted for proliferation studies by Chávez and Swed (2021). The demand-side analysis in the proliferation domain is originally intended to explore and understand the motivation by which actors show interest in acquiring such capabilities. The supply-side, on the other hand, looks for the conditions to acquire and field a particular platform, with focus on financial, technical, and infrastructural capacities. Based on this theory, this study will focus on the use of UAS as a starting point to answer the research question. By applying a methodology of structured, focused comparison, with the help of the above-mentioned theory, it will be possible to compare with more clarity and depth the differences and similarities between the analyzed cases.

1.6 TERMS AND DEFINITIONS

Uninhabited Aircraft Systems

For the present study, the term “uninhabited aircraft systems” (UAS) was chosen over other definitions, including “drone”, “unmanned aerial vehicle”, “remotely piloted aircraft” for several reasons.

Different sources in the literature classify this technology in a variety of ways. “Unmanned Aerial Vehicles” (UAV), a slightly better description, can sometimes give the understanding that it is an autonomous robotic killer platform, which does not have a man-on-the-loop (Fowler, 2014).

The term “unmanned aerial vehicle” can be misleading, because although in the near future the system may operate autonomously, the most common nowadays is the human-machine interaction, through remote operation. Finally, the term “remotely piloted aircraft” has

the implication that the platform does not have autonomous flight modes. For these reasons, this study considers that “uninhabited aircraft systems” is most precise and the term that generates the least confusion in relation to the issue under study. The term “drone” is also used here, but just to facilitate readability.

Non-State Armed Group (NSAG)

Additional Protocol to the 1949 Geneva Conventions (Protocol II) defines non-state armed groups in its article 1.1 as “dissident armed forces or other organized armed groups” who fight regular armed forces or against each other on the territory of one or several states (International Committee of the Red Cross, 1977).

In general, such groups can be characterized by resorting to violence as a way to achieve their goals, not being formally organized as state institutions, and behaving in a more autonomous way in relation to politics, military operations, resources and infrastructure. The fact that they are supported, covertly or openly, does not exclude them from such a concept, and even state officials or agencies may be directly or indirectly involved in their activities, for various reasons (religion, ideology, interests). Even because of this, as they are not under state control, they are often attractive to government agencies, as they may act indirectly on their behalf (Hofmann and Schneckener, 2011, p.604).

Airpower

Airpower is defined as a collective term that includes all forms of military means of power that use the airspace, and not just the combat aircraft with its weapon load (Lambeth, 2018, p.21). Air power thus includes both offensive and defensive means of force such as air defense, UAS and helicopters. Cruise and ballistic missiles are also included in the definition. Artillery and rocket artillery, on the other hand, are excluded.

1.7 DISPOSITION

This study is structured in 6 chapters. After the introduction, chapter 2 presents the research overview covering what researchers have written about UAS and how the theories, if any, have been used in other scientific research about their use.

Chapter 3 presents in more detail the theory behind the demand- and supply-side of proliferation, whose premises will be used to guide the investigation.

Chapter 4 presents the chosen method for answering the research question – an explanatory multiple case study – with an operationalization framework based on the theory.

In Chapter 5, analysis is conducted to explain the use of UAS by both actors of the comparison. In addition, possible alternative explanations, other than what theory establishes for the UAS, use are raised.

Finally, in Chapter 6 I discuss the use of current theory and the general conclusion remarks about implications of the investigation. Suggestions are also made for further research.

2 RESEARCH OVERVIEW

The aim in this chapter is to give an overview of previous research, mainly focusing on how the use of UAS and its proliferation have been studied previously. This overview aims to identify a gap in current research on the topic, which this study intends to help fill. The study's contribution is described at the end of the chapter.

2.1 ORIGINS OF UAS USE AND OTHER STUDIES

The use of UAS as a military tool started in World War I, when in 1917 the United Kingdom tested a radio-controlled Sopwith Camel aircraft filled with dynamite. Already in the Second World War, both sides of the conflict were already using it on a larger scale, both as anti-aircraft targeting (US) and as remote bombing (Germany), the latter being deployed for the terror bombing of London. In 1960, development of drones increased after the U-2 incident, when an American pilot was shot down over the Soviet Union, in an attempt to reduce the vulnerability of pilots (Ehrhard, 2010). In the Vietnam War, US used UAS to conduct surveillance missions, as did Israel in the Lebanon War, to find future targets for piloted aircrafts (Dobbing and Cole, 2014, p.8). Unarmed UAS, such as the US's Predator, were used for surveillance in the 1990s war in the Balkans. However, it was only armed and used on a larger scale after the events of 9/11, in the war on terror, when US deployed Predators with Hellfire missiles in Afghanistan (Ehrhard, 2010). From then on, unarmed and armed drones continued to spread internationally.

The use (or attempted use) by NSAGs dates back to 1994, when the cult of Aum Shinrikyo tried to use drones to spread poison gas in Japan. Today, groups such as ISIS, al Qaida, Hamas and the Houthis have increasingly used this platform in missions such as reconnaissance and surveillance, messaging, weapons of mass destruction (WMD) and improvised explosive device (IED) delivery, and also as weapons platform itself (suicide attacks) (Bunker, 2015). Hezbollah, for example, in 2016 successfully used a UAS to drop explosives while hovering over its target. ISIS extensively and successfully used weaponized UAS for multi-role purposes, by modifying existing commercially available quadcopters and fixed-wing drones (Haugstvedt, 2020, p.93). Al Qaida, despite not having implemented it, got to test remote controlled planes to use chemical weapons, and the Taliban reportedly used UAS in order to watch US troop movements (Haugstvedt, 2020, p.95).

There is still extensive debate about the advantages and disadvantages of using UAS. Among many advantages, the most cited by researchers are persistence, lower operating costs, positive public perception due to low collateral damage hazard and less political risk for involvement in a conflict, because of the limited ramifications of a crash. Furthermore, for the casualty-averse public, there is a reduction in physical presence and, therefore, risk to forces. From a strategic communications perspective, there is no risk of a humiliating “Blackhawk Down scenario”, and from an operational perspective, less political risk equates to additional flexibility (Fowler, 2014; Zegart, 2020; Grieco and Hutto, 2021).

In terms of disadvantages, among others, it is claimed that UAS have more restrictive weather limitations than their manned counterparts, and are effective only out of a tactical standpoint and in killing, not in conflict resolution (Fowler, 2014; Cronin, 2013). Furthermore, and maybe the most important disadvantage, is the limited technological significance that increases its vulnerability to air defense systems, resulting in less effectiveness when operating in hostile airspace (Horowitz et al., 2016). Doctor and Walsh (2021), additionally, when studying coercion attempts by NSAGs, recently argued that while drones can serve as a force multiplier, those systems do not embody a transformation in modern insurgent warfare.

There are also theorists who debate the moral and ethical issues of using this technology, in addition to aspects such as international relations and legal considerations (Peron and Dias, 2018; Chamayou, 2015; Der Derian, 2009; Birdsall, 2018). As one of the most cited authors on the subject of debate, Chamayou (2015, pp.49–50) cites the elimination of reciprocity, or direct dispute between the parties, reducing it to a simple 'human hunt' against the weaker side, which only has the conditions to flee or hide. This would make war more impersonal and increase its radicalization. Der Derian (2009, pp.241–244) uses the term *Virtuous Wars*, in the sense that the representations of drone use in the government discourse create a kind of moral distancing from the war, pushing the conflicts away from reality. Finally, Birdsall and Miller (2018; 2016, p.252) question the US drone policy when acting as a norm entrepreneur of the international law, trying to legalize its acts with drones in “target killing”. Those issues may affect the drone use by states, but when it matters to non-state groups use, it can differ substantially.

2.2 UAS PROLIFERATION STUDIES

In the debate about the proliferation of military technology, the first theories were adopted initially for researching nuclear proliferation (Sagan, 2011; Gartzke, 2001; Fuhrmann, 2012; Sagan, 1996). In this sense, initial approaches to solve the puzzle in proliferation research were broadly divided between supply or demand literatures (Sagan, 2011).

When studying the use of UAS in the current world scenario, current literature appears to be mainly interested in the issue of its adoption and proliferation, both between states and armed groups. In this sense, research seeks to find the best factors that characterize those possibilities (Milan and Tabrizi, 2020; Rossiter, 2018; Horowitz et al., 2022; Boyle, 2015). The studies are mainly divided between three ways of explaining proliferation: using Adoption Capacity Theory (ACT), Demand- and/or Supply-side literature or combining both.

Studies based on the ACT try to give a better understanding of the diffusion of new technologies. The theory argues that adoption depends mainly on the innovation requirements and the organizational capacity to meet them (Gilli and Gilli, 2014; Horowitz, 2010a). Horowitz (2018) applies this theory to raise the concerns about drone proliferation developments in various scenarios, including both state and non-state use. Following the same path, Rossiter (2018) explores which devices have been used and by whom.

Studies that otherwise base their research on the “demand- and supply-side” theory, highlight factors such as the capability and desire to acquire a military technology (Horowitz et al., 2022). Andrea and Mauro Gilli (2016), for example, make considerations about technology and logistics to operate drones, making them difficult to proliferate. Horowitz et al (2022), in a further study, use the theory to develop trends in proliferation among democratic and non-democratic states (regime type), and how likely countries facing (terrorist and territorial) threats will adopt UAS (Fuhrmann and Horowitz, 2017), as this technology is becoming more accessible. Finally, Chávez and Swed (2021) include NSAGs in the proliferation equation, using the theory to argue that NSAGs have the resources, capacity, and interest to advance their aims.

These debates turned to UAS only recently, but still inside a state side scope, helping to understand adoption and proliferation. This is because UAS technology is becoming cheaper and more accessible to any organization that has an interest in using it, in addition to being an effective weapon in war. Clear and recent events can prove this, such as the conflict in

Nagorno-Karabakh in 2020 and the 2022 war between Russia and Ukraine, where drones made and are making a positive difference for users, even in contested airspaces.

2.3 RESEARCH CONTRIBUTION

States are not prepared to guarantee security against an opponent that has policies and ideologies other than the usual, and which does not share the same limits, intellectual and/or institutional (Hoffman, 2007, p.56). At the same time, asymmetric conflicts where the NSAGs are not conventional military forces, will increase. Their methods of using different tactics are especially interesting for developing the theories that study the use of airpower, as it entails new threats and problems (Hoffman, 2007, p.37).

The literature review shows that there is, among other things, an assumption that the use of airpower presupposes significant resources for an actor to have relevant results, reducing the importance of NSAG use. It also shows that the question about why NSAGs use UAS remains answered only to a limited extent. Even if drones are considered less “revolutionary”, as some analysts argue, they nonetheless influence international peace and stability in significant ways (Horowitz et al., 2016).

Additionally, the study's relevance lies in the fact that it increases our understanding of the use of UAS as an important airpower asset, and additionally addresses whether the existing theories should be perceived as distinct to state and NSAGs, or if they can be considered applicable in a broader context. Furthermore, the results of the study can contribute to reflections on the practical use regarding doctrine development, planning, education and, by extension, strategy.

Finally, it is worth saying that drone proliferation and adoption, both for states and non-states, is still in the early stages. Thus, understanding the “why” of this diffusion in an early stage lowers the risk of post-hoc outcome bias, influenced by the knowledge of possible outcomes. This becomes more difficult with more mature technologies because of the danger that knowledge about the real-world may inadvertently infiltrate and influence the theoretical discussion, affecting its development.

3 THEORY

This chapter aims to establish a basis and a starting point for the empirical analysis of the study, based on demand- and supply-side theory. From then on, the uses of UAS can be contextualized for a better development of the theme of this study.

This study consists of Chávez and Swed's (2021) theory to explain drone proliferation by NSAG. In particular, the model they used aims to explain motivations and interests behind the adoption of such technology.

3.1 DEMAND AND SUPPLY-SIDE THEORY APPLIED FOR UAS PROLIFERATION

Initial approaches to solve the puzzle in proliferation research were broadly divided between supply or demand literatures (Sagan, 2011). In the debate about proliferation of military technology, the original “supply-demand” terminology of classical economic theory, was adopted initially for nuclear proliferation studies as prediction factors (Sagan, 2011; Gartzke, 2001; Fuhrmann, 2012; Sagan, 1996). But, as Simon Jenkins (2013) summarized, “The greatest threat to world peace is not from nuclear weapons and their possible proliferation. It is from drones and their certain proliferation”.

Interest, capacity, and context together drive a technology adoption (Fuhrmann and Horowitz, 2017; Esaiasson, 2017; Gilli and Gilli, 2016; Horowitz, 2010a). Based on this idea, Chávez and Swed adapt Sagan's demand- and supply-side models to study how drone proliferation could not only happen with states, but also with non-state groups, when including in the scope commercially made ones.

The theory argues that while supply-side reasoning considers issues such as budgets and infrastructure, demand-side considerations look at interest and motivation. It addresses the subjective part of demand-side research by documenting the advantages of a certain platform, which complements supply-side cost concerns.

Demand-side considers how an innovation might contribute to an actor's agenda, identity, and security environment. However, the authors note that reasoning and even observable behaviors are not direct proof for motivations; instead, they combine benefit logic with practical examples of usage and language that coincide. Thus, they divide the demand-side approach in three fronts, as follows:

- **Security environment:** The threat environment is considered by many authors as the primary demand driver for military innovation (Chávez and Swed, 2021).

States live in an anarchical international system, according to neorealist political science theory, and must thus rely on self-help to safeguard their sovereignty and national security. Any state (or non-state) seeking to safeguard its national security must balance against any adversary by acquiring deterrent technologies (Sagan, 1996, p.57). Although UAS are used as coercive means to force changes in the status quo, the most common and simplest cause of proliferation is a straightforward emphasis on responding to emergent threats. Thus, the employment of UAS by one side prompts the use of UAS by the other. Fuhrmann and Horowitz (2017) also discover that states dealing with territorial disputes and terrorism are more interested in this initiation, and that the type of demand is mediated by regime type, with democracies preferring UAS for their capital-intensive qualities and autocracies preferring them for their surveillance capabilities. In a similar way, for states and non-state armed groups, the expectation is that they may have different views on how to act with UAS, even when facing the same context. A state may use it for loitering and presence, while a NSAG may see drones as a way to undermine adversary capability.

- **Normative allure:** States are compelled by status standards, which serve as crucial symbolic roles in forming and expressing their identity (Sagan, 2011, p.63). A novel military technology's successful adoption can also impart a normative status of modernity and cutting-edge capabilities. Status and prestige are thus also measured in terms of a reference group: for states, it's other states, and for NSAGs, it's other NSAGs (Chávez and Swed, 2021). The "new institutionalism" literature in sociology indicates that contemporary organizations and institutions often develop to resemble one another not because of competitive selection or rational learning, but because institutions imitate one another. Individuals and organizations may have "interests," but those interests are shaped by the social roles actors are supposed to play. They are sought according to habits and routines as much as through rationalized decisions, and are ingrained in a social environment that encourages certain structures and behaviors. Military institutions and their weaponry may thus be seen as part of what nations think they need in order to be legitimate (Sagan, 1996, p.65). From this sociological standpoint, for a NSAG, drones for intimidation and propaganda are supposed to

be the best way to represent and show their identity and status, while for a state, UAS use may not be the best asset to show its influence and resolve, as other means can be more representative.

- **Normative constraints:** This indicator states that norms also serve as constraints. It relates to standardization norms selected into normative-legal frameworks. First, militaries must answer to a variety of stakeholders, including command structures, budget and procurement agencies, political leaders, and the general public. This applies to the security and dependability of all individuals and equipment. Second, nations comply with normative-legal frameworks such as armed conflict laws, international humanitarian law, and human rights regimes. They must evaluate things like the last resort threshold, discrimination and proportionality. Thus, UAS must be equipped with high amounts of capacity to meet these requirements and its user may have to comply with these norms in their acts (Chávez and Swed, 2021). A law-abiding state, in this case, may feel partially restrained in the use of UAS in its missions, to avoid breaking laws. For a NSAG, who usually do not abide by international conventions or treaties, this presupposes making no difference in their use of drones.

Supply-side model, according to Chávez and Swed, examines whether an actor can acquire and field a particular platform. This model focuses on financial, technical, and infrastructural capacities to assimilate new systems and subsequent doctrines, as shown below:

- **Financial intensity:** This indicator refers particularly to the resource mobilization conditions involved in attempting to adopt a major military innovation (Horowitz, 2010, pp.30–31). It is basically assumed, then, that the higher the cost, the fewer the actors who will be able to afford it. Drones of military quality are expensive to manufacture, import, operate, and maintain. Many states, let alone non-state entities, cannot afford them. The consequence is that only those with the greatest economic resources will use UAS. Whether the invention is solely military or includes dual-use commercial applications is also a crucial aspect in evaluating financial intensity. It means that the underlying technology that drives a military innovation can take many forms. If it originates from an essentially commercial technology, in which case private businesses have economic, non-defense incentives to develop it, it will normally demand smaller net capital investments.

If it is an essentially military technology, invented for military purposes and arousing little initial interest from businesses other than defense contractors, it will cost more (Horowitz, 2010, pp.30–31). In the case of military drones, for example, the market can be tightly regulated. In the opposite way, civilian ones are facilitated by accessibility and a wide range of purchase options (Chávez and Swed, 2021). Regarding a state actor, it is not expected to have major problems when funding drone programs, as the choice of use is made. For a NSAG instead, it may try to look for affordable alternatives or “partners” to assemble enough drones, sufficient to make a difference when used.

- **Technical capacity:** Adoption necessitates the development and mastery of significant engineering abilities (Gilli and Gilli, 2016, p.71). Most of the subcomponents must be optimized and integrated as the platform becomes more capable and robust. Military drones are built to cover large areas in a variety of climatic and atmospheric circumstances, hover for long periods of time at medium and high altitudes and collect very granular sensory intelligence data. Combat drones, for example, are designed to drop precision weapons with the use of laser target acquisition, guidance systems, and remote command inputs (Chávez and Swed, 2021). Drones, it may be argued, can be imported, bypassing the technological requirements of research and development. Even if heavily controlled, the technological capability required to field, operate, and repair military UAS exceeds the technical capabilities of many nations and most NSAG. Military drones are, thus, attainable only by the most sophisticated nations, according to common sense and a plethora of literature (Chávez and Swed, 2021). It is expected then that a state, with supposed know-how, uses drones mostly as a redundancy factor, as it may have other comparable or better assets to use. A non-state armed group, on the other hand, may have a limited use due to a lack of knowledge, counting instead on commercially available innovations.
- **Infrastructural capital:** Finally, the more training and infrastructure required, referring to non-technical characteristics, the fewer the military bureaucracies will be able to manage it (Gilli and Gilli, 2016). In terms of training, any hardware requires a set of proper codes, practices, and doctrines, as well as a competent, organized staff, in order to offer its advantages. In general, the importance of the

operational issue is a product of previously existing skills. The greater the gap between requirements and existing capabilities, the more difficult and expensive it will be to adapt. In terms of infrastructure, all invention requires some form of logistical and infrastructural backing. The essential questions are if a country already has it, if it has to acquire some skills, or if it needs to construct the full package from scratch. The greater the difficulty, the more constrained the country's current capabilities are (Gilli and Gilli, 2016, p.60). In terms of communication and satellite connectivity, data collection, and intelligence analysis, drones are among the most resource-intensive military vehicles. Only the most infrastructure-resilient players will employ UAS according to this rationale, as financial and technological requirements. It demonstrates that players who can purchase and accept military-grade drones have access to strong, effective, and dependable war machines. For those who can't, commercial drones may provide middling airborne performance for a fraction of the cost and with far less capacity (Gilli and Gilli, 2016). The assumption is that a state, in this case, relies on its global infrastructure and strategic partnerships to project its power through the use of drones abroad, while a NSAG may seek to maintain constant smuggling lines and rely on the ease and automation of employing new technologies to overcome their deficiencies, also limited for regional use.

3.2 THEORY DISCUSSION

The adoption of a technological innovation as a contribution for a state or a non-state group to achieve proposed objectives is, to some degree, part of their strategy. In this sense, this research understanding is that its use can also be supported by the same elements established by Chávez and Swed's theory. What is needed here is to adapt each of these elements in a way that best reflect and connects intentions to the actual use. This is because, as could be seen, such studies about the adoption and proliferation mostly based their assumptions on probable future intentions of use, with few actual examples, and mainly based on other examples of technology adoption. Thus, this study aims to add knowledge on use, seeking to find out if the theory's assumptions are valid.

In summary, the selected theory serves as a compass to initially guide steps through the still unexplored use of UAS by NSAGs in comparison with states. The historical events

covered give a clue as to how the use can be effective by both cases. More interesting yet is that past conflicts had different opponents and results but, until then, NSAGs did not have an air power to use, being more studied as targets in the use of UAS by states and not as enforcers of this means.

4 RESEARCH DESIGN

The aim of this chapter is to describe how this study is structured to analyze and answer the research question. Initially the starting point and method of data collection, i.e. comparative multiple case study are described. After that, the cases are stated, within the scope of comparing the use of UAS, and the sources of research criticized. Finally, the theory will be operationalized in the sense of becoming measurable and therefore analyzable.

4.1 SCIENTIFIC THEORETICAL STARTING POINT

As the objective of this study is to explain the use of UAS, and from that arrive at new conclusions, the positivist scientific tradition is adopted. This means that the thesis has an explanatory deductive approach to the cases being investigated, with the aim of finding connections between the chosen theory and the different ways of using drones by both actors (Porta and Keating, 2008, p.26). Being an explanatory study also means that it is possible to test, question and refine theories through a novel case with an explanatory theoretical framework (Porta and Keating, 2008, p.227).

Being qualitative, this study emphasizes words more than numbers. Different from quantitative research, the qualitative study lacks a large amount of observations and numbers, but for the same reason, it can be more detailed (Fejes and Thornberg, 2019, p.35). Although quantitative research is generally better when explaining and finding correlations between variables, qualitative research is good at finding causal relationships (David and Sutton, 2016, p.83).

4.2 CHOICE OF METHOD

4.2.1 Comparative Case Study

As the purpose of this study is to investigate the use of UAS, a comparative multiple case study is useful as a method, meaning that its results show whether the tested theory would be able to explain the event and be thereby generalizable for similar cases (George and Bennett, 2005, p.109). Moreover, as this study focuses more on a phenomenon of innovative technology adoption translated to its use by states and non-state groups, using historical events (Yemeni crisis) only as a context, it matches with the purpose of case studies (i.e. what is this a case of?) (George and Bennett, 2005, p.27).

Case studies are effective tools for theory testing, according to George and Bennett (2005, p.115). Yin (2018, p.110) also argues that the conclusions drawn from multiple cases are more persuasive than those of a single case study, and the combined results are stronger if the data from the two case studies are examined and presented at the same time. They are, however, seldom intended to entirely invalidate the theories they examine. Rather, the purpose is to assist in determining if the theory will and will not operate under different circumstances. Thus, a comparative case study is used to examine the context and characteristics of two cases of a specific phenomenon in greater depth. The purpose of comparative case studies is to uncover differences, similarities, or trends across the cases, which is a significant distinction between the two approaches. These findings, in turn, aid in the development or confirmation of the theory (Mills et al., 2009, p.174). In this way, the use of a comparative case study approach allows me to thoroughly examine the two cases and acquire a comprehensive understanding of why states and non-state groups differ in the use of UAS.

4.2.2 Structure, Focused Comparison

The study uses George and Bennett's (2005, p.67) approach, the method of structured, focused comparison. The goal behind this approach is to stress certain aspects of historical cases. This is accomplished by addressing general questions to the data which make the findings generalizable and represent the study's research purpose and theoretical focus. These questions assist standardized data gathering, allowing for cross-case comparability. The goal of this method is to be able to apply cases findings to "a broader, more complex theory" (George and Bennett, 2005, p.67). The technique is "focused," in the sense that it only looks at particular features of the cases. The "universe," or the type of event, must in this way be defined for the use. For this thesis, this is the use of drones among states and non-state armed groups. The questions must be formulated in such a way that they are based in both the theoretical approach and the thesis's research objective. This is due to the fact that a case study cannot completely investigate every component of a case and must instead select which parts are essential to the research. These are the elements that are important to the theory that has been chosen. "The format of structured, focused comparison will not yield good results" if this isn't done correctly (George and Bennett, 2005, p.68).

The analysis should be driven by a clearly stated research objective and an appropriate research design to attain that objective. In addition, for the sake of explanation, case studies should implement variables of theoretical importance (George and Bennett, 2005, p.68). This

is where the theory enters the picture. Thus, the six factors that constitute the demand- and supply-side model are the study's independent variables. In order to operationalize the variables, both the study's aim and the research question must be considered. The study then investigates the independent variables' degree of impact on the dependent variable, use of UAS (Table 1). Following the idea of George and Bennett's structured, focused comparison, the independent variables are investigated via indicators (Table 2) based on particular questions. As a result, the findings may either strengthen or weaken the theory (George and Bennett, 2005, p.59). These aspects operationalize Chávez and Swed's theory allowing this study to look at the measurements.

4.3 CASE SELECTION

The most significant criterion for case selection is its relevance to the research objective (Mills et al., 2009, p.61). Therefore, I choose to compare a case of non-state group use of UAS (Houthis) with a case of state use of UAS (US), both nested in the context of the Yemeni crisis. This crisis provides an interesting context for studying drone use as at the same time it covers the US - a UAS technology holder with an extensive know-how and experience (Boyle, 2015, p.77; Bunker, 2015, p.7), and the Houthis - who have been employing UAS more recently and in a wider range of uses.

As drone technology is recent, the study covers a relatively short period - from 2011 to 2022. Perhaps a slightly older context would have given more opportunities to collect data and make broader conclusions about the use of this technology, but such use by non-states groups or similar organizations has only developed recently (Haugstvedt and Jacobsen, 2020).

From initial research, it was possible to perceive that this "differentiated" use of UAS by an NSAG offers several aspects that make it worth studying in greater detail. The unpredictable nature of NSAG's actions has been researched for a long time (Horowitz, 2010b; Gilli and Gilli, 2014). However, the interesting and little explored use of drones to expand their unpredictability makes it more interesting. Studying the unusual role of airpower in these issues increases the understanding of how it can be used in possible future conflicts, whether with or without the participation of NSAGs. Therefore, the use of drones is the aim of investigations in the cases, including how and why it has been employed by both sides to carry out their objectives. The analysis of these cases is theoretically justified because both actors in the conflict used UAS, implying that the framework used in the study can be evaluated on each of

them. In addition, the constituted variables to be studied have the potential to present variation among them (George and Bennett, 2005, p.83). As it is expected that the UAS is used in order to win to the best of its capacity, but to varied degrees by each case, it may result in variation in terms of their interests and willingness. Furthermore, in the selected cases, UAS may be seen as a standalone resource as well as a complement to other power sources. The Yemeni crisis is therefore a context that fits well with this study.

4.4 OPERATIONALIZATION

In order to obtain high conceptual validity and reliability, operationalization seeks for consistency with the original theory (Yin, 2018, pp.42–47). As a result, to follow the operationalization of the variables, the aim of the study must be regarded as well as the research question and theory.

Through definitions and the construction of indicators, operationalization implies transforming abstract theoretical concepts into visible and tangible units (David and Sutton, 2016, p.186). In this regard, questions and indicators were created, taken from the theory in question. This provides the essential structure and focus on the cases, as the two cases are compared and only important data is analyzed (George and Bennett, 2005, p.67). The goal is to answer these questions in order to close the knowledge gap that has been found. The scope and targeting of the operationalized questions are within a problem that has to be addressed. They must be broad enough to apply to both situations in the comparison while being specific enough to be consistent with the theoretical framework. If one wishes to extend into conducting additional cross-case comparisons using this study as a foundation, this balance is also worth considering (George and Bennett, 2005, pp.73, 86). There are two stages to the analysis in the framing of questions. The first step is to collect appropriate empirical data in order to answer the questions. This will be done using a descriptive method in which data will be collected using qualitative text analysis, with the goal of mapping how the US and the Houthis employ UAS based on the theoretical principles. The study intends to identify the cases' demand- and supply-side factors in which the strategies operate.

The second step is to determine what parallels and differences exist between the two cases and how they may be explained, as well as to analyze what those answers indicate for the research objective, which is the case study's conclusive stage (George and Bennett, 2005, p.90). The method's comparative aspect is the choice to ask the same questions with each case.

This has been useful in this thesis because it has enabled analysis of the respective cases’ factors and it improved uniformity in material analysis and collecting, while the general questions help to prevent bias in the examination of individual cases. The steps will be described in more detail below.

As the intention is to answer the questions through a structured, focused and comparative method, the analysis is of an explanatory nature (George and Bennett, 2005, p.67). The results of the first step of the analysis are in this way compared between the actors to identify why there are differences in their use of drones.

From the above explanation, the analytical work takes place in three steps and the tools are presented below based on these steps:

- Step 1: The variables are defined, as well as identified and coded in the empirical data (indicators).
- Step 2: Variable values are specified and assessed, with regards to the degree of impact that the independent variable has on the dependent, i.e. subjective valuation.
- Step 3: Cases results are compared, and an analysis summary is presented.

4.4.1 Step 1: variables definition, identification and codification

Dependent variable: The dependent variable that will be analyzed in both cases is the use of UAS. To compare the selected cases, this variable requires a presupposition of conditions that encompass its meaning, as presented in the Table 1 below. This makes empirical research more focused on finding the real impact factors of independent variables on the use of UAS.

Dependent Variable	Conditions
Use of UAS	<ul style="list-style-type: none"> - Under the actor’s directions and administration, not isolated use. - Any category or grade of UAS, commercially or military made, but purchased and/or manufactured for military or “military-like” use. - Aimed to have effect at any level of the conflict, from strategical to tactical.

Table 1: Conditions of the dependent variable

Independent Variables: The essences of Chávez and Swed’s theory, adapted for the use of UAS, are the demand- and supply-side factors, each one divided in three subcategories. For this study, these factors are expected to explain and affect the use of UAS by states and non-state groups and why they differ, considered therefore the independent variables. Based on the

theoretical framework of the thesis, UAS demand-side is composed of three variables: security environment, normative allure and normative constraints. In the same way, the UAS supply-side is composed of financial intensity, technical capacity and infrastructural capital. *A priori* to the investigation, no one indicator translated by the theory is judged to be more significant than another with the exception of *security environment*, as stated by the theory (Chávez and Swed, 2021). Therefore, the analysis is expected to show that this variable, as for innovation matters, has also a high degree of influence on the dependent variable. Still, an equitable distribution across the other variables in their degree of effect on the dependent variable is expected. In short, all factors stated in the framework are supposed to affect UAS use, if the method used helps the analysis to evaluate the theory and so be deemed to explain the differences in use, accounting also for possible alternative explanations.

Each general question stated below addresses one of the independent variables that could affect the UAS use:

1. Has status or change in the security environment influenced the use of UAS?
2. How is the normative allure identified by the actor through UAS?
3. To what extent do the normative constraints limit the use of UAS?
4. How is the financial intensity managed for the use of UAS?
5. To what extent does the technological capacity limit the use UAS?
6. How does the actor's infrastructural capacity promote or limit the use of UAS?

To guide the measurement of the independent variables, a set of indicators are stated, as showed in Table 2:

Independent Variables		Indicators
Demand-side	Security environment	<ul style="list-style-type: none"> - Existence and status of internal and external threats - Existence of territorial disputes and/or terrorist actions - Existence of asymmetry gap between the actors' military capabilities
	Normative allure	<ul style="list-style-type: none"> - UAS identified by the actor as a status advantage - UAS identified as an identity symbol - UAS use as reference to other similar actors
	Normative constraints	<ul style="list-style-type: none"> - UAS use affected by national laws and norms - UAS use affected by international laws and norms - UAS use affected by reliability and dependability standards
Supply-side	Financial intensity	<ul style="list-style-type: none"> - Financial investment required - UAS as an alternative for avoiding other costs - Dual-use UAS capabilities present
	Technical capacity	<ul style="list-style-type: none"> - UAS use affected by technological and engineering skills - Support regarding know-how from partners
	Infrastructural capital	<ul style="list-style-type: none"> - UAS use affected by military infrastructure - Personnel status regarding training and support - Alliances to support logistics and use - Intelligence gathering to support the use

Table 2: Indicators of the independent variables

4.4.2 Step 2: Variables values are specified

After identifying how the indicators are translated by the empirical material, according to the theory, their values need to be determined and assessed, thus measuring the explanatory power of each independent variable. In this way, variables will be coded as ordinal variables and categorized as *high*, *moderate*, *low* and *null*. This assessment is made qualitatively depending on the presence and influence of each internal indicator. While less precise than a quantitative study, it provides for a great amount of interpretation, allowing a better view of how the independent variables interact with the usage of UAS. It also aids in identifying which elements are most crucial.

4.4.3 Step 3: Cases comparison and analysis summarization

After the individual analysis, both cases' results will be compared and each variable value stated. Also, a variable summary will be presented as the Table 3 below.

Indicator <i>Step 1</i>	Value and impact <i>Step 2</i>	
Demand-side	State	NSAG
<i>Security environment</i>		
<i>Normative allure</i>		
<i>Normative constraints</i>		
Supply-side		
<i>Financial intensity</i>		
<i>Technical capacity</i>		
<i>Infrastructural capital</i>		

Table 3: Independent variables summary model

4.5 MATERIAL

The structured, focused comparison method allows for the use of any suitable findings of empirical data in order to obtain answers to the operationalization's general questions (George and Bennett, 2005, p.87). Thus, the study's source material consists mainly of books, scientific articles and newspaper articles and news, available either online or in printed form, thus considered secondary. Military official doctrine was also used (in the case of US) to better understand the UAS *modus operandi*. When it concerned news articles, the evidence found was evaluated by other media articles, to assess its veracity and bias. Furthermore, when comparing and using different sources, the aim is to triangulate, that is to combine sources of information while switching between analysis and interpretation, thus improving overall credibility and quality (Yin, 2018, p.126). This is also beneficial because it is possible to check data from one source against the others found to assess its authenticity.

This study relied heavily upon studies conducted by and based on previous researchers on the proliferation and adoption of drones, such as Sagan and Horowitz (Horowitz and Reiter, 2001; Fuhrmann and Horowitz, 2017; Horowitz, 2010a; Sagan, 1996, 2011). Those and other authors chosen to establish the theory and its adaptations were meticulously evaluated by posterior works and evaluation of their allegations by other authors.

Although the use of UAS by some non-state actors has been reported, there is limited literature on how insurgents might employ UAS to achieve their goals. Furthermore, many of

the conflicts in which these systems arise are current due to the nascency of use by these actors and their capacity to acquire and/or develop UAS. Yet, because Yemen is mired in conflict, academics have restricted access to the country or must discriminate between disputed information.

Hearing from all actors, a type of balance through distribution, becomes very difficult, because the Houthis do not generate any kind of easily reachable work concerning their activities, doctrine, etc. Furthermore, the organizations' strongly biased information sources (their websites and/or TV channels) make it difficult to trust. Nonetheless, the emergence of social media and the capacity to disseminate information broadly provides an excellent understanding of how these weapon systems are used. Furthermore, because the conflict is still ongoing, the majority of the sources have only recently been released, reducing the potential of progressive factual distortion owing to, for example, forgetfulness, therefore increasing credibility (Thurén, 2019, pp.42–43, 74).

When considering ethical matters, as a positivist setup this study seeks a complete separation between the observer and what is observed, taking care not to 'contaminate' the research by becoming part of it (Porta and Keating, 2008, p.31). For this matter, the analysis is performed using deductive coding, which means that the categories are created before their execution (first-level coding) to focus on what the source theory actually represents, increasing also its precision and transparency (David and Sutton, 2016, p.58, 274). Subsequently, the text data is coded and then compiled based on the thesis' boundaries and the operationalization indicators (David and Sutton, 2016, p.276). From this approach, the aim is that all the indicators of the theory can be recognized in the empirical sources, as the different codes (or layers) correspond to different justifications of use, helping to increase the study's internal validity (Esaiasson, 2017, pp.154–156).

Finally, the focus only on the US as and the Houthis as actors in the Yemeni crisis, despite being a limiting factor, contributes to the reliability of this study (Yin, 2018, p.46), when highlighting their UAS use characteristics. It is known that a number of other states are involved (such as the Saudi-led coalition) in the crisis management, and also NSAGs such as AQAP, that are affecting it. However, the intention in this study is to provide a better understanding of the chosen actors' role.

5 ANALYSIS

This chapter aims to analyze if the theory supports the expectation that the use of UAS differs between states and NSAG. The first section provides a general overview of the Yemeni situation to provide context and make the subsequent sections more readable. The broad overview is followed by the case-specific presentations in which the empirical data is presented in greater depth. The case presentations are followed by individual analysis of the cases, with variables relating to the use of UAS. After this, the theory's explanatory power is tested with a comparison between cases, based on the theoretical framework of the thesis. The case comparison is concluded by a summary of the findings, also addressing possible alternative explanations for the results.

5.1 BACKGROUND - THE YEMENI CRISIS (2011 – 2022)

Following 9/11, the US's overall attitude aimed ameliorate the situation in the Middle East and, as a result, reduce the likelihood of additional terrorist attacks on their soil (Hastedt, 2018, p.244). Along this line, they began to employ their capabilities to counter terrorist groups and state sponsors abroad. The resurrection of the Yemeni AQ branch, which would prove to be a substantial transnational danger, was identified by the US Central Intelligence Agency (CIA) from 2008. President Barack Obama labeled it as the most "dangerous and aggressive." Thus, since 2011, Yemen saw a dramatic increase in counterterrorist missions in Yemen (Bolland and Ludvigsen, 2018).

However, the Yemeni President Ali Abdullah Saleh proved to be a highly erratic US partner, and the US struggled to provide effective counterterrorism support or a regular lethal strike campaign (Hartig and Hathaway, 2022). When the President was overthrown in 2011–12, after ruling Yemen for more than three decades, the Yemeni Crisis began (Day and Brehony, 2020, p. xii). The new government, led by Abdrabbuh Mansur Hadi, fought to unite the country's delicate political landscape and keep threats away from both al Qaeda in the Arabian Peninsula (AQAP) and Houthi militants. The Houthi insurgency became a civil war in 2014, when their forces marched into Sana'a (Middle East Eye, 2015). The pressure continued until Hadi resigned in January 2015, when the Houthis took control of the government and Hadi fled to Aden, being then supported by Saudi authorities. Saudi Arabia then joined forces with the United Arab Emirates (UAE) and formed a Saudi-led coalition (with nine Arab countries in total), commencing air attacks in Yemen and extending the ongoing

conflict until the current day, with accusations on both sides that have intensified it (Day and Brehony, 2020, p.xiii).

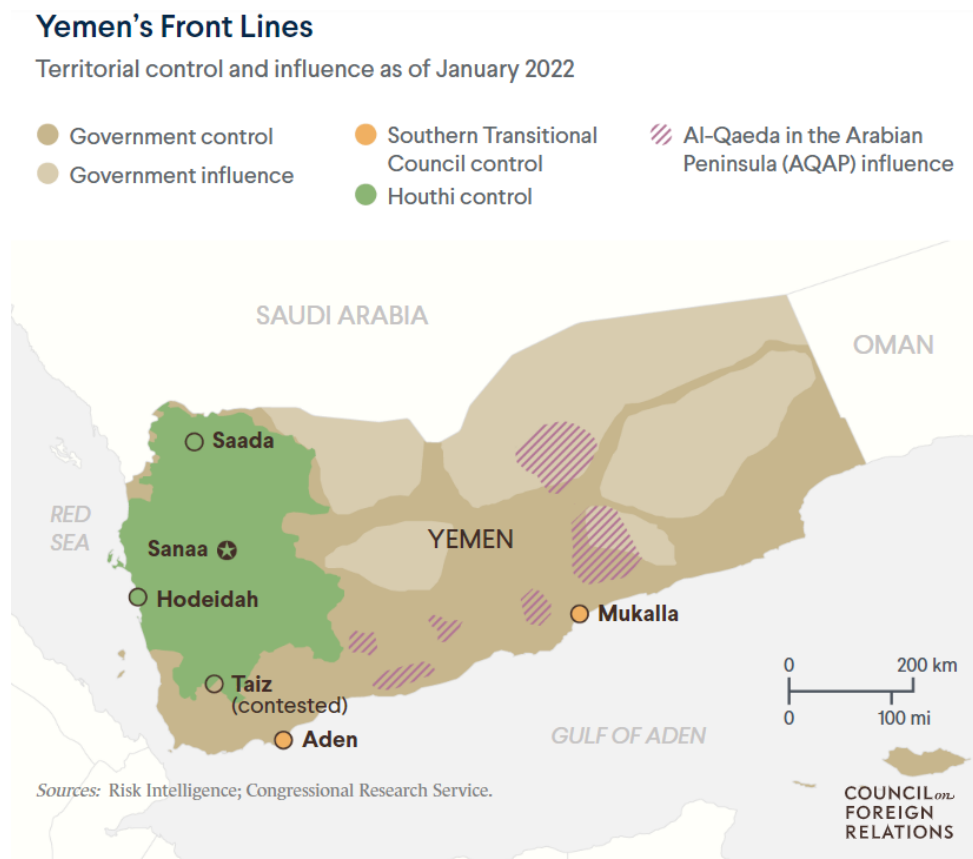


Figure 1: Yemen's front lines (Robinson, 2022).

5.2 THE US USE OF UAS

Since 2002, a large number of US drone strikes have been reported in Yemen, where AQAP has grown stronger (Bolland and Ludvigsen, 2018). With the prospect of deploying drones in Yemen, which was consistent with Obama's goal of "no US boots on the ground" in the war against AQAP, the number of verified drone strikes in Yemen climbed significantly, but with a large number remaining unconfirmed (Bolland and Ludvigsen, 2018). The US drone program grew dramatically as a result of Obama's policy turn away from counterinsurgency and toward pinpoint targeting of terror organizations (Greco, 2021, p.18). The incoming Donald Trump presidency prompted a significant increase in US counterterrorism activities in 2017. One of the new president's first acts was to restrict presidential control of US military operations in Yemen, labeling portions of the state "active hostility" zones (Radman, 2019).

The US use of UAS is analyzed below through the indicators based on Chávez and Swed's theory. The purpose is to assess the explanatory power of the theory.

5.2.1 Demand-Side

Security Environment indicator

With regards to US foreign policy in the Middle East, it emphasizes, among other things, national economic growth, oil price, national security, nuclear threats, arm reduction and terrorist threat. The policy is largely influenced by the US relations with Israel and Saudi Arabia and the desire to block the increased Iranian influence in the region. The main aim is to establish security on all levels through fighting terrorist organizations and prevent attacks on the US (International Crisis Group, 2019). Amongst several, the overall aim of the US's counterterrorism (thus, drone) policy, is to protect the American people by countering and preventing the evolving terrorist threat overseas to eliminate “safe heavens” for terror networks (The White House, 2018, pp.7–9).

Specifically in Yemen, where the aim is to stabilize and unify a country where transnational terrorists no longer operate, the use of UAS was seen as an effective solution. The US intention, stated innumerable times by President Obama, when adopting these technologies was to avoid the political and social costs of sending ground contingents, or ‘boots on the ground’ (CBS News, 2010). Into such a chronically unstable country, which tended to hinder the effectiveness of traditional forms of military intervention (US Joint Chiefs of Staff, 2013), the UAS use was seen as a way to reduce the asymmetry gap between forces. Allied to this, Yemen's uncontested airspace is favorable to the use of UAS, given its clear limitations in air-to-air and surface-to-air defensive countermeasures or combat capabilities (Chávez and Swed, 2021).

President Obama admitted that the ability of drone strikes when reducing risks by the deployment of ground forces turned them in “cure-all for terrorism” (Koebler, 2013). Thus, the operational benefits of drones, such as their precision and low exposure of their pilots, have made them the best choice for US counterterrorism campaigns. Military operations, in this regard, have used drones to directly kill terrorist militants and destroy their capabilities, as well as provide surveillance (Grieco and Hutto, 2021).

Finally, this drone war can be understood as an important asset in the pallet of US political choices, augmenting not only their power projection, but how they understand the whole war on terror in Yemen.

Normative Allure indicator

The US objective is the continuance of its global hegemony while internally trying to decrease the effects of globalization (International Crisis Group, 2019). The US already has a great status and prestige, simply because it is already the largest military power in the world and a leader in the use of UAS, especially in the war on terror after the events of 9/11. Its best known UAS are copied by other countries, such as China and Russia, being therefore a reference in the subject.

The 'age of the drone', as it is commonly reported in the media around the world, has been a way of attesting to the fame of drones in counterterrorism missions carried out by the US. But while drone strikes are undertaken in official war theatres by the US Air Force, strikes in Yemen are conducted in secrecy through programs operated by the CIA (Kearns, 2017). This use of drones was initially authorized as part of a 17 September 2001 Presidential Directive, which pre-authorized covert worldwide operations targeting al Qaeda suspects for assassination. These “executive orders” approved US actions outside official conflicts, which led to today's CIA programs in Yemen (Kearns, 2017). Those strikes are conducted covertly, intending that the role of the US sponsor “will not be apparent or acknowledged publicly” (US Code, 2013, sec.3093). Covert strikes means, in this case, a limited possibility of major understandings, due to lack in public knowledge (Kearns, 2017). Thus, what in the past was used as an American symbol and identity in wars around the world, has now been hidden.

There is a contrast also between counterterrorist and previous counterinsurgency missions fought in other lands. In Yemen, counterterrorism does not focus explicitly on winning local populations' hearts and minds, or place any emphasis on the host nation's ability to govern over them (Sepp, 2005, p.9). This is mostly why the US actions were conducted unilaterally against terrorists and with its own interests in mind.

Normative Constraints indicator

Speaking initially about norms of reliability, production and safety standards of US-produced military UAS used in Yemen, there is no doubt that they follow the highest standards. Like other military equipment, they are submitted to several phases, from the initial design to testing the use and employment of weaponry. As equipment that is sold to other states, it must also comply with international norms and standards (Hambling, 2015).

On the other hand, regarding the normative-legal frameworks, the US has acted to cover up its UAS operations, as already mentioned in the previous indicator, for several reasons.

One reason is that there may be political costs associated with capturing suspected militants, so the drone attacks aim to kill rather than capture. The US argues that arresting militants in unstable areas where they are found is risky (Horowitz et al., 2016). But the reality is that the process of prosecuting terrorist suspects in US civilian courts can become a domestic political burden, as seen with the Guantanamo Bay prison situation (Bruggeman et al., 2021). This strategy only helps to reflect the meaning of US drone campaign in Yemen: avoid social and political negative impact.

Nonetheless, the US government argued that their global war on terror is legally justified by the right to self-defense, stated in Article 51 of the UN Charter (Reisner, 2018). However, targeted killing of individuals on foreign soil outside of armed conflict, except in extraordinary circumstances, is not allowed by the same Charter and also other international treaties (Boussios, 2017). Furthermore, Yemen's government, which had embraced US counterterrorism operations under Saleh's presidency (until 2015), has explicitly denied their right to deploy drone strikes on its soil under Hadi's leadership. The UN responded this by adding that the drone strikes were illegal under international humanitarian law (Qureshi, 2020). Despite that, with the advantage that drone attacks give in terms of their deniability, compared with alternatives such as ground forces, which require a considerable logistical footprint, or manned aircraft, the US still conducts their operations (Horowitz et al., 2016).

5.2.2 Supply-Side

Financial intensity indicator

The use of drones in military operations is far cheaper than conventional military interventions (Peron and Dias, 2018). Even for the US, budget is an issue that in some way influences their operations. During the Obama administration, for example, they had to face a dilemma: growing budgetary expenditure and criticisms of involvement in the Middle East on the one hand (mainly because previous experiences in Iraq and Afghanistan), and the pressure from specialists and other governments to keep the military involvement in the region on the other. Even the UAS Reaper-MQ-9 costing about US\$6.48 million and about US\$3.250 per flight hour, it is still far cheaper than a F-35 Joint Strike Fighter, that costs about US\$91 million and US\$160.000 per flight hour (Peron and Dias, 2018). Drones also cost substantially less

than other military options. Deploying just one battalion of 300 soldiers to Afghanistan for one year costs about US\$246 million (Zegart, 2020).

But, as analyzed in previous indicators, this “easier” form of projecting power illustrates the core of the US drone campaign in this context: avoid social and political negative impact. The main objective is not to use UAS to reduce costs; it is to avoid boots on the ground, with its potential for legal issues and consequent risks.

Technical capacity indicator

For the US, UAS technology, despite being advanced, is not different or disruptive when compared with other assets. Because of this, they are usually fitted for a limited range of tasks and offer functional redundancy (Joshi and Stein, 2013). But for the Yemeni environment, where secrecy, deniability and the need of loitering for extensive durations in the search of terrorist was a priority, it became an ideal asset.

The possibility of performing target killing and signature strikes, the modus operandi of the US in the war on terror, was also an alternative to other means, reducing collateral damage. For example, in 2009, the US launched a Tomahawk cruise missile from a submarine near the coast of Yemen, killing fourteen AQAP operatives and forty-one local residents. Those mistakes only served as a powerful weapon in the hands of AQAP "to bolster recruitment." As they were demonstrably not so accurate for those type of missions, the Obama administration decided to turn to the use of drones (Plaw et al., 2015).

Infrastructural capital

The US is well known for being the world reference for the use of drones. Their logistics embrace the world, allowing their UAS to operate across the globe without restrictions. Doctrine and training are also strong points. US possess an uncountable number of publications that direct their actions such as, for example, Joint Publication 3-26 on counterterrorism operations (Joint Chiefs of Staff, 2014). The US is a pioneer of unmanned systems, having deployed drones such as the MQ-1 Predator since the mid-1990s. It has more expertise than any other nation when it comes to using armed and unarmed drones (RANE, 2019).

But what matters to the Yemeni crisis is the possibility of the US to fight a remote warfare, i.e., the ability to “project its power in a discriminate and agile way to overpower

conventional opponents” (McDonald, 2021). They have created efficient capabilities to do so using "low footprint" techniques of involvement that would otherwise need the deployment of large-scale ground forces and possible public backlash against the government's use of force. For example, the United States' deployment of drones can rely on a variety of international partners, such as Germany, for intelligence gathering and base protection, as well as shared infrastructure (McDonald, 2021). This remote warfare, or "riskless warfare" appeals to policymakers, as can be seen in the US preference for drone and air strikes instead of ground operations in the figure 2 below.

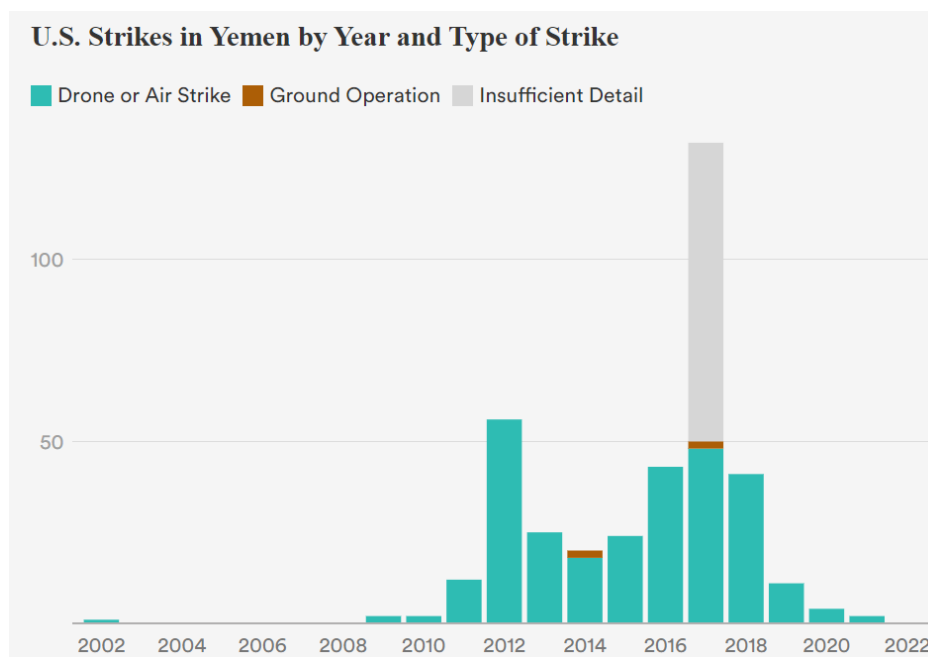


Figure 2: US strikes in Yemen compared (New America, 2022).

5.3 THE HOUTHI USE OF UAS

Ansar Allah or the ‘Partisans of God’, is referred to as the Houthi movement since it is led by the Houthi family (Vakfi and Vakfi, 2018). The Houthis declared a new government in Yemen after President Hadi and his government were forced to resign in January 2015. They seized the weapons of the Yemeni Army and established parallel institutions of the state (Huzaifah and Othman, 2016). Their goals at this time were to secure the northern border and keep the Saudi-led coalition out of Yemen's internal conflict. As they failed to fulfill these goals, they strengthened their ties with Shia friends in the region. As a result, Iran's role in the Yemen conflict has become more open, and drone deployment has been more widespread. Following the launch of Saudi Arabia's Operation “Decisive Storm” in late March 2015, Houthi members attempted to capitalize on the humanitarian catastrophe caused by foreign aggression

to elicit sympathy and create support at all levels, including local, regional, and global (Day and Brehony, 2020, p.247).

The Houthi military spokesperson, Brigadier General Yahya Saree, said in 2019 that the insurgency has increased its drone inventory and that "this year will be the year of the drones" (Hambling, 2021). Since 2016, Houthi fighters have used deadly UAS types against the Saudi-led coalition and Hadi-backed forces. While they continued to acquire the majority of their drones from outside sources in 2020, they did appear to begin producing parts for at least one model of UAS in Yemen in 2018 (Conflict Armament Research, 2020, pp.4–6).

The Houthis use of UAS is analyzed below through the indicators based on theory of Chávez and Swed. The purpose is to assess the explanatory power of the theory.

5.3.1 Demand-Side

Security Environment indicator

NSAG's threat environments are characterized by asymmetry, when compared with state power and wealth, as well as a constant conflict situation, as they are inherently hostile (Chávez and Swed, 2021). For the Houthis' situation, they have to constantly manage their forces against the Yemeni government and the Saudi-led coalition to fulfil their political objectives (Archambault and Veilleux-lepage, 2020). The use of UAS then could be explained as a way to improve the efficiency in pursuing that objective. Drone attacks, such as the one in 2019 against forces allied with the Yemeni recognized government (Al Jazeera, 2019), show a clear intention to expose the actual government's lack of means to defend itself, at the same time posing a threat to the Saudi-led coalition.

To overmatch the Saudi-backed forces and to attack from the air, civilian- and Iranian-made drones were the last resort to destroy missile defense systems provided by Saudi Arabia (Boyle, 2020). The loss of international support by raising the economic costs of the coalition with drone attacks is also a valid assumption. The influence of drones on these costs could be seen in the 2019 drone assault on Saudi Aramco oil facilities, which momentarily cut off 5% of world oil supplies (Faucon and Saidd, 2019). Additionally to this strategy, they allegedly attacked softer targets to disrupt sources of logistical support, combining ballistic missiles to attack harder targets that were protected with air defense systems, which could intercept drones more effectively (Doctor and Walsh, 2021). This could be considered successful as the UAE withdrew its ground forces from Yemen in 2020.

Adding to the poor performance of the Yemeni government to provide basic services like food distribution and security, with additional internal problems in the armed forces, the Houthis used UAS to further erode the situation, by attacking Yemen's armed forces, in suicide drone missions (Boyle, 2020).

Normative Allure indicator

During the Yemeni crisis, unlike the US, the Houthis have been keen to publicize the use of UAS for several different reasons. They do this through websites that support them and even through their own television channel, Al Masirah, founded in 2012.

In 2021 the Houthis even organized an exhibition of their "Made in Yemen" weaponry. Called the "Martyr Leader Exhibition for Military Industries" (Bunker and Keshavarz, 2021), Houthi leaders showcased new armaments and other munitions in order to highlight their status and capabilities. Furthermore, when they perform attacks using drones, they usually claim responsibility, as stated by the group's military spokesman Yahya Saree in an attack against Abu Dhabi in 2022: "The armed forces carried out ... a successful military operation within the framework of an operation named Yemeni Hurricane" (Al Jazeera, 2022a). This attack against Abu Dhabi was a clear message to show their capability and status of modernity.

They are also successful in spreading the UAS use as a reference to other NSAGs, being a symbol for them to follow. For example, Iraq's Iran-backed Asaib Ahl al-Haq militia 'congratulated' the Houthis for its drone attack on Abu Dhabi. They said: "We congratulate the oppressed brothers in Yemen [the Houthis] on the glory and steadfastness. They are defending their country and their people against the unjust aggression of an unjust coalition" (Khalid, 2022).

While the tactical advantage of using UAS by a NSAG is limited, their symbolic value against the Saudi-led coalition and their territories is significant. By inflicting reputational and political damage with their acts (Muhsin, 2019) they have built an image of resilience against states with vastly superior military capabilities. Recent efforts to kill Yemeni military commanders and target infrastructure deep within Saudi Arabia (Archambault and Veilleux-lepage, 2020) show that armed drone systems have become an important component of their propaganda arsenal. Separate from the immediate security threats posed by the drones and the

weapons they use, the employment of UAS may also include a symbolic contestation of their sovereignty.

Normative Constraints indicator

The Houthis, similarly to other NSAG, do not have the budget and the know-how to produce UAS of the same standard as states. To get around this problem, the Houthis looked for two alternatives. Initially, they relied on the dual-use capabilities of civilian platforms, adapting those drones to carry weapons or performing surveillance (Schulzke, 2019). In 2015, they started flying with a DJI Phantom series quadcopter – a commercially available hobbyist system – stolen from a local television station (Muhsin, 2019). Later, they relied on the help of external sponsors, namely Iran, for direct supply or assistance in their own production of UAS (Archambault and Veilleux-lepage, 2020). In 2017, the extent of the group’s UAS ambition increased and became clearer as they claimed to have produced systems indigenously (Muhsin, 2019). Clearly its potential will not match that of wealthier states, as this production itself is very dependent on the civilian market and access to that supply, but at least it demonstrates some intention to improve the standard of its drones to better fulfill its objectives with less losses.

Furthermore, the Houthis are not law-abiding. Because of that their use of UAS and their targets do not follow any kind of law of armed conflict (Human Rights Watch, 2015). This, on the contrary, provides more opportunities against law-constrained states. If they, for instance, limit the use of UAS, it will be as a result of other reasons (internal norms, for example).

5.3.2 Supply-Side

Financial intensity

If US UAS are cheaper than military planes, Houthis’ ones are even cheaper, so much so that they are sometimes viewed as rounds of ammunition, emphasizing their expendable characteristic (Hammes, 2016). The cost of building some of the bigger drones used in the September 2019 assaults on Saudi Aramco sites and cities was believed to be as low as US\$15.000. This cost is similar to the building of a suicide car bomb, which ranges from US\$13.000 to US\$20.000 (Doctor and Walsh, 2021). Deadly drones can be constructed for a

few thousand dollars since the cost of such a smart weapon is quite low, and the parts needed to build it are readily available on the internet (Abaad Studies & Research Center, 2019).

Additionally, the Houthis count on an illicit network managed mainly by Iran that smuggles petroleum and other commodities around the Middle East, Asia and Africa to help fund them (Al Jazeera, 2022b). Iran has also supplied drones to Yemeni rebels fighting Saudi Arabia. They do so because the Houthis are considered to be part of the so-called "Axis of Resistance" (together with Iran, Lebanon's Hezbollah, and Hamas) against Israel and the US (Yemen Analysis Hub, 2020, p.2).

As stated in the previous indicator, the Houthis do not have the same budget to produce UAS as states. Therefore, they relied on the dual-use capabilities of civilian platforms, adapting such drones to carry weapons or perform surveillance (Schulzke, 2019). As already stated, they relied on Iran for assistance in their production of UAS. Clearly its potential will not match that of wealthier states, as this production itself is very dependent on the civilian market and access to that supply (Archambault and Veilleux-lepage, 2020), but it demonstrates that they somehow prioritize their finances to increase the use of UAS.

Technical capacity

Unlike the US, where the drone is used more as a means of redundancy, for an NSAG, this technology opens up countless possibilities that were previously unattainable. Also differently, achieving an American technology level is something unattainable, so they look for other ways to obtain it, such as the "partnership" with Iran or through commercial drones and parts of drones (Juneau, 2021). Civil drones, for instance, marked the beginning of their operation with this type of platform in 2015. Its rapid evolution towards the production of drones, despite claiming that they are their own production, is contradictory. They claim to have produced systems indigenously and began to emphasize the range of armed UAS at their disposal. But the seizure by the UAE Presidential Guard of a truck containing several unassembled Iranian-built Qasef-1 UAS in November 2016 cast further doubt on the technological and design abilities of the group (Bunker and Keshavarz, 2021).

In 2021, they demonstrated substantial progress when they unveiled a variety of "Made in Yemen" weaponry, as already commented on in the "Martyr Leader Exhibition". On that opportunity, Houthi leaders showcased new drones and weapons, as the UAS Samaad-4 with a range of 2.000km. Proof of the effectiveness of those UAS are, for example, successful

attacks against far targets as the Saudi Aramco facilities, military bases, and cities in Saudi Arabia and UAE in 2021, using drones and ballistic missiles (Bunker and Keshavarz, 2021).

They proved the capacity to employ different reconnaissance and combat UAS from assembled imported parts in combination with domestically manufactured components, showing a growing development of domestic capabilities. Furthermore, from suicide non-weaponized UAS, more recently they have employed longer range versions with explosive payloads. As they don't have great technical capacity, they rely on smuggling smaller commercial components, sometimes identical to those contained in Iranian UAS (Conflict Armament Research, 2020).

Infrastructural capital

The capabilities related to training and infrastructure for the operation of UAS by NSAGs are directly linked to the objectives of this type of organization. Kydd and Walter, when describing the strategies of the terrorist framework, state the drones are being used for attrition, intimidation, provocation, and spoiling (2006). Despite no longer being labeled as terrorists, the Houthis have similar behaviors and goals. For such purposes, the requirements are far lower than what is needed for a state, with a formal air force, logistics and doctrines strictly delimited.

The Houthis' public statements indicate that drone assaults are part of their larger "Balance of Deterrence" program (Shaif, 2019). Overall, their drone systems may have a better possibility to accomplish this strategic objective, although they have not exploited their fleets to fundamentally change the conflict in their favor. Logistical and materiel constraints limit their capacity to utilize drones for strategic goals against state adversaries (Doctor and Walsh, 2021). Effective use of UAS necessitates widespread and continuous attacks on an opponent's centers of gravity.

Furthermore, they usually do not take full advantage of their "sophisticated" UAS full capabilities because they do not possess the technical know-how (lacking in training and doctrine). As an example, they programmed their drones with open-source GPS coordinates to destroy radar sets of the Saudi-led coalition's Patriot surface-to-air missile systems, instead of doing this by previous reconnaissance (Rossiter, 2018).

Further research, on the other hand, demonstrates that Houthi "drone use" is "continuous and developed enough to be called a program." This is because they have used

drones frequently enough or have developed a sufficiently recognizable infrastructure, committed to support such operations (Archambault and Veilleux-lepage, 2020). Yet, according to research regarding the components and manufacturing of these devices (Haugstvedt, 2020), Iran is indicated to significantly help the Houthis with training and logistics issues. Hezbollah's influence has also allegedly existed in the training of Yemeni militants as early as 2014. An examination of their actions, such as targeting Saudi Arabian sites and devising influence techniques via the use of media campaigns, reveals that Hezbollah cadres in Yemen have shared their lessons from anti-Israel activities (Samaan, 2020).

5.4 SUMMARY OF THE RESULTS

After analyzing both cases individually, it is possible to infer some conclusions about how and why the US and Houthis differ in the use of UAS. Starting with the demand-side variables, initially with the *security environment*, even though the two actors are sharing the same conflict context, their direct targeting is against different opponents, despite their actions are also indirectly linked against each other. The US uses its UAS mainly in a war on terror scenario in a distant and dangerous territory for its troops, but practically unrestricted for the use of drones. With this, it seeks to achieve results by avoiding being exposed politically and against public opinion, operating in secrecy. For the Houthis, the situation is one of survival, resorting to drones as a way to achieve their goals against much more powerful opponents (external and internal), through actions that undermine them. Having wide support from Iran, which has similar interests regarding the same opponents, the Houthis manage to have greater amplitude in their actions with the use of drones. As can be seen, all the indicators that represent this variable (internal and external threats, territorial dispute/terrorism and asymmetric gap) have a high value of influence for the choice and use of UAS in both cases; thus its value is considered to be *high*.

Regarding the *normative allure*, due to the negative reputation that the UAS created during previous conflicts for allegedly killing indiscriminately, the US sought secrecy in its operations, an attitude that is contrary to the one generally taken during conflicts in which it participates, where it seeks to openly show its status and power as reference to other nations. UAS have become the perfect tool to maintain this low profile. The Houthis, on the other hand, have exactly the opposite behavior, as their objective is to intimidate their opponents. Drones then become their platform of choice, along with the use of missiles, to demonstrate their

warlike might, increasing the chance of fulfilling their goals. As the UAS are a tool of easy access and great impact, they manage to make the repercussion of their actions global, still managing to be a reference to other NSAGs. The conclusion, when comparing the indicators (status, identity and reference), is that the two cases have totally opposite objectives when identifying the UAS as the main platform to represent (or hide) them during the Yemeni crisis. In this way, for the US, this variable does not justify the use and is judged to be *low*, while for the Houthis it is one of the main reasons, then justified as *high*.

Concerning the variable *normative constraints*, the US drones can be considered as a world reference in matters such as dependability and effectiveness, following the highest quality standards. This was found ideal to fulfill missions in which they have the risk of (or actually are) infringing international laws. Their strategy, based mainly on killing rather than arresting, avoids political and social attritions such as the prisoners of war resulting from the case in Afghanistan, who were tortured in Guantanamo prison. Likewise, drones increase the deniability of operations in Yemen, as the US has been accused of breaking international law in its operations. In the case of the Houthis, who have no "concerns" about complying with laws or standards for the production of drones, their possibilities become practically limitless. They use drones with commercial parts and of dubious quality, and do not meet the limitations of the law, such as proportionality in their attacks or differentiation of combatants. Their attacks are then known for using drones in conjunction with missiles, using tactics that are sometimes prohibitive and with high collateral damage, but effective to achieve their goals. As the indicators (reliability/dependability and international/national laws and norms) for the US are judged to have opposite values when limiting their actions, its variable value can be judged as being *moderate*. Conversely, for the Houthis, the indicators do not limit them at all when employing drones. Thus the variable value is assessed to be *null*.

Regarding the demand-side variables, for the *financial intensity*, the US recognized in drones the opportunity to maintain its power projection and military involvement in Yemen, even with internal complaints about spending, as this platform costs a fraction of other air assets and ground troop funding. However, this reason had less weight in the current context since the US priority and the purpose of using UAS concerns more deniability and secrecy, not budget. In the case of the Houthis, two factors helped them in the extensive use of drones: firstly the support by Iran and also the use of commercially available parts and drones (dual-use application), cheaper and easier to access than the restricted military equipment, but more

than enough for their objectives and operations. As evidenced, the indicators of this variable (financial investment, lower cost alternative, dual-use capabilities), although important, did not represent entirely the choice for UAS in both cases uses, i.e., it was not a limitation or an alternative justification when managing its use. Thus, the variable value for both cases is judged to be *moderate*.

Furthermore, the *technical capacity* shows some differences in why both parties used UAS. For the US, UAS was not a disruptive technology in relation to its other means of combat, being normally a redundant means in its application. However, given the better accuracy to perform signature strikes, when compared to ballistic missiles, especially in terms of collateral damage, they were the best choice. Despite that, this indication was shown to have limited explanatory power, as its choice as the platform in use had the true objective of providing deniability during its actions. For the Houthis, the technological gap in relation to the US made no difference when having such a platform available, since, as already mentioned, Iran's support and the use of part from the commercial market were already enough for drones to have a use for them, never before imagined. For their limited objectives, comparing with a state, this proved to be more than enough. In addition, they have shown a strong growth in the manufacture of UAS, further expanding the range of their attacks. As the indicators (technological and engineering skills, and aid from partners) reflected, the cases have some differences for this variable. For the US, mastering the UAS technology does not limit but also does not entirely justify its use, as the aim is to keep the low profile. Thus the value is assessed to be *moderate*. Instead, the Houthis, who even though are far behind in terms of technology that could limit use, still show results with drones, justifying the variable value as *low*.

Finally, regarding the *infrastructural capital*, with its worldwide capacity to project power and using international partners to support with logistics and intelligence, for the US it is easy to employ their “remote warfare” with UAS. They can avoid drawing unnecessary attention to their acts, not to mention the skills and doctrines already acquired in the use of UAS from past conflicts. From the Houthi side, their limitations are far greater regarding training and infrastructure, but the low requisites overcame such limitations. Furthermore, the proximity to Iran, and the large territory occupied in Yemen facilitates their logistics. The limitations of doctrines and training have been overcome with the increasing automation of drones but prevents them from better exploring the possibilities. Thus, the indicators of this variable (infrastructure, training, alliances, logistics and intelligence) were great facilitators

that justified the reasons for US use of UAS, comparing its advantages with other available assets, assessing then the value as *high*. Conversely, the Houthis managed to overcome most of the limitations imposed by the indicators with the logistic aid by Iran, choosing the drones anyway, and assessing the variable value as being *low*.

The Table 4 bellow summarize the interpreted weight of each independent variable, for a better understanding.

Indicator <i>Step 1</i>	Value and impact <i>Step 2</i>	
Demand-side	US	Houthis
<i>Security environment</i>	High	High
<i>Normative allure</i>	Low	High
<i>Normative constraints</i>	Moderate	Null
Supply-side		
<i>Financial intensity</i>	Moderate	Moderate
<i>Technical capacity</i>	Moderate	Low
<i>Infrastructural capital</i>	High	Low

Table 4: Independent variables summary

The analysis shows that the cases examined, US and the Houthis, confirms Chávez and Swed’s theory when used to clarify the explanations of use. But at the same time, it suggests that not every indicator must be weighted as high for an effective use and proliferation of the UAS. For NSAGs it was expected that supply-side factors would weight more negatively, since they usually do not possess the same technological know-how as the major states. However, even with low supply-side results, they found alternative ways to overcome the limitations, as they saw in drones an important tool for their demand-side driven objectives and was not limited by any constraints.

For states, all the factors were supposed to justify the proliferation, but even for the US, not all of them matters, depending on the conflict. In this specific case, the need for secrecy and denial that only UAS could provide, which also influenced practically all other indicators, resulted in a weight totally opposite to what was expected in the *normative allure* factor. That is, a state may also desire to adopt and use the UAS for secret missions, without expecting that

it represents a symbol or its identity. This behavior had an impact in the supply-side variables, the ones with greater weights, that acted more to support that intention.

Finally, the *security environment* variable high weight was a confirmation that, no matter in which side, actors will always seek to adopt and use an innovation to overcome potential and real threats (internally or externally). In the cases studied, UAS was that innovation.

Table 5 bellow summarizes the empirical findings of each independent variable and helps understanding what the variables weights were based on.

Variables	Value	
	US	Houthis
Demand-side		
<i>Security environment</i>	<ul style="list-style-type: none"> - Avoid the political and social costs - Uncontested airspace for UAS - Reduce asymmetry gap 	<ul style="list-style-type: none"> - Reduce power asymmetry gap - Iran support - Bring about an end to the Saudi-led intervention - Undermine public order
<i>Normative allure</i>	<ul style="list-style-type: none"> - Secrecy - Low profile - Deniability 	<ul style="list-style-type: none"> - Military and propaganda arsenal: status - Reference to other NSAG - Demonstrate strength and resilience
<i>Normative constraints</i>	<ul style="list-style-type: none"> - Norms of dependability and efficacy - Avoid political risk and social costs - Violating International laws 	<ul style="list-style-type: none"> - Lack of budget and the know-how - Dual-use capabilities of civilian platforms - Not limited by normative-legal frameworks
Supply-side		
<i>Financial intensity</i>	<ul style="list-style-type: none"> - Budget vs military involvement - Cheaper than fighters and troops 	<ul style="list-style-type: none"> - Limited budget: using instead civilian drones and/or parts - Supported by Iran
<i>Technical capacity</i>	<ul style="list-style-type: none"> - Ideal for target killing and signature strikes - More precise: avoid collateral damage 	<ul style="list-style-type: none"> - Opens previously unattainable possibilities - Technology shared by Iran and commercial drones - Partially manufacture own parts and drones
<i>Infrastructural capital</i>	<ul style="list-style-type: none"> - Reference in the use of UAS - Remote warfare 	<ul style="list-style-type: none"> - Training and infrastructure limited - Logistic and material constraints - Count with UAS automacy

Table 5: Comparative summary

5.5 ALTERNATIVE EXPLANATIONS

During the analysis, other variables that may impact the utilization of UAS were evidenced. They are described in the following paragraphs since they were not included in the theory and first analysis.

Horowitz's theory of diffusion of military innovations (2010), on which Chávez and Swed are partially based, cites the issue of organizational capital, which is divided into three categories: critical task focus, experimentation and organizational age.

Critical task focus means how specifically a military organization defines its critical task. The more specifically defined, the harder it should be to adopt an innovation. This could be related both from how the military formal structure is formed and also is the flexibility is of their leadership and decision-making process. *Experimentation* means that actors best prepared for disruptive innovations are those with ongoing experimentation efforts. Finally, *Organizational age* holds a basic prediction that as organizations age, as they become more rigid and less inclined to innovate (Horowitz, 2010a, pp.35–38).

For the US it is far easier to attest the weight of organizational capital. They possess, for example, a Defense Innovation Unit inside the Department of Defense (DoD). Yet, inside the DoD, the Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)), Prototypes and Experiments (P&E) uses experimentation to support innovation and develop solutions to vexing military problems (Department of Defense, 2021). Thus, even though they have an aged organization, they have found ways to avoid stagnation and are the nation that most often uses UAS in their actions.

The Houthi case is far more difficult, as is not possible to assess their chain of command or formal structures. What is known is that in less than two decades, they have transformed from a handful of individuals chanting anti-imperialist slogans to an organized political and military force (Yemen Analysis Hub, 2020). Thus, despite the fact that it is difficult to be sure about how they reached this status, the organization capital indicators could be assumed to have made some difference in their innovation process. Horowitz used a similar example with suicide terrorism, stating that terrorist groups with pre-existing operational profiles before the era of suicide terrorism had extreme difficulty adopting the innovation (2010a, p.166).

However, after analyzing the above indicators, it was found that they would make more difference in adopting or not an innovation than in the way they have been used by both actors, which was not the focus in this research.

6 CONCLUSION

In this chapter the theory used will be discussed based on the study's analysis. Initially, Chávez and Swed's adapted theory about the proliferation of drones and the assumption that it can explain the difference between state and NSAG use of UAS is discussed. Then, some reflections will be made about the study's scientific method and choice of cases. The chapter follows with concluding remarks that links back to the study's aim and problem formulation and ends with suggestions for further research.

6.1 PROLIFERATION THEORY AND THE USE OF UAS

As reviewed in chapter 3, Chávez and Swed's supply- and demand-side proliferation models have a broad scientific basis. The indicators that they used were based on several studies on the subject, in a way that each strong and weak point could be criticized to get the better result, with few gaps. They even expanded the subject to hitherto underexplored actors, providing additional points of view on the issue. This gave scope for their new approach to be expanded in the current study, by testing it in order to create new knowledge in the use of UAS. Thus, the use of drones was analyzed under the premise that the indicators of demand- and supply-side could explain by which motives the actors differs in their behaviors. The variables, in this way were used in a distinct way from the theory, not focusing on why the UAS may proliferate (a more futuristic prognostic), because it has already proliferated (present statement).

Chapter 4 described the logic behind adapting the present theory to analyze selected cases, using focused, structured comparison, and establishing significance and influence values for each indicator and subsequent variable. This was a way of translating the theory so that it could be used for this new interpretation. Then, the requirements for adoption and proliferation were interpreted and transformed into questions that could give them new meanings, in addition to facilitating empirical research. As the theory used was tested here for the first time, regarding explanations on the use of UAS, the choice of indicators that represented the variables may require adjusts/amends if adopted in other contexts or cases.

From the results presented during the analysis in chapter 5, it can be seen that the independent variables were really able to clarify the vast majority of the "hows and whys" of the use of UAS by two different actors, even in a way that made it possible to differentiate them. Although the variables were good at explaining, it could be seen that they were not

always what the theory argued as conditions to use UAS in an effective way. That is, not always the greater the weight of the variable, the greater the probability of proliferation and/or use. The supply-side variables weighed more for the reasons of US use, while the demand-side variables leaned more toward the Houthis. Also, as expected according to the theory, the *security environment* demand-side variable was the only one equally highly prominent in both cases, reflecting the importance of this issue when choosing the UAS for use. This is even so for the US, mostly because their strong supply-side motives were based on the security issue.

Furthermore, as well as the fact that a single theory cannot explain all facets of a phenomenon, alternative explanations have been found, which may also possibly complement the reasons for different use of UAS. Nevertheless, the analysis from the initial criteria showed that the present theory “passed” the test and has strong explanatory power to analyze the use of UAS, with still further motives to continue researching in this field.

6.2 REFLECTION

This thesis aimed at contributing to the use of UAS (as military innovation) research field by filling the research gap about the ways and reasons states and non-state groups use UAS. The thesis was guided by the research question *how and why do non-state armed groups differ from states when using Uninhabited Aircraft Systems in their military operations?* To answer this questions, I introduced and tested a theory in a novel way, about drone proliferation, originally built to stipulate the probability of adoption of drone technology, depending on the degree to which the demand- and supply-side indicators are met by a specific actor.

The variables presented in the theory were financial intensity, technical capacity, infrastructural capital, security environment, normative allure and normative constraints. In this regard, the analysis showed sufficiently clear results for certain conclusions to be drawn, which gave new knowledge about the tested theory. As may have been perceived, the initial formulation of the problem already assumed that there would be differences between the understandings of the use of UAS by different actors. It was supposed from that first moment that the priorities of each case could drive differently the demand and supply factors. Thus, all indicators used were found to affect somehow the use of drones by each actor, the supply-side ones more the states and the demand-side more the NSGAs, which also provided support for using the theory. This results then corroborated the expectation of differences, by verifying that

each factor weighs differently on how a state and a non-state group decide to use a new technology, and how they adapt to overcome those factors in which they are weak.

It is important to emphasize that the above analysis was possible to be made because of the qualitative design, that allows non-definitive operationalizations. Thus, the assignment of variables values into *null*, *low*, *moderate* and *high* was made only to provide a better basis for comparison and discussion of the cases. Regarding the generalization of cases studies, already discussed on chapter 4, the present results must be used with caution. The given focus and cases used must be considered. Thus, based on this multiple case study, the use of UAS by states and NSAGs in other contexts may differ when weighting the variables. For example, in the currently studied state's side, the US is a powerful country that sometimes becomes blinded by its power and need for global influence, which gives it the feeling that it can just ignore international laws to fulfill its objectives. It also has international partners that support its global war on terror, allowing the implementation of a remote warfare. Other states would differ in some of these and other raised aspects. On the other side of the comparison, the Houthis grew up fast in their capabilities in the use of drones, mainly because of external support, which could be different when studying a NSAG that had to count on its own resources, at least regarding the supply-side of the results. In summary, the structure of this thesis allowed me to utilize UAS usage in a broad definition when looking to both cases, but for other scenarios it would be interesting (or necessary) to develop more focused units of measurement that could be easily compared. Still, the important factor and the ambition with the chosen context was that it encompasses cases which, in addition to being chosen on theoretical grounds and being relevant in relation to the research question, have occurred in the recent past in order to examine the theories' explanatory power in relation to modern air power. Thus, they can reflect with more veracity possible future scenarios and comparisons.

Finally, both theoretical and empirical research have been aided by this thesis. It has provided a fresh explanation as to how and why states and NSAGs differ in their usage of UAS by expanding the theory with new approaches. This thesis has thus contributed empirically by providing data on two instances of drone use. These findings add to our knowledge of the usage of drones and how it impacts in military strategy and international security, essential for doctrine- and policymakers, and also academics alike.

6.3 FUTURE RESEARCH

The findings of this study warrant further research into the demand- and supply-side theory and the effects it has when researching the motives states and NSAGs have when choosing which platform can make a difference in conflicts. This statement is valid for two main reasons. The first is because the theory used, although is adapted from previous theories, was not tested in any other work but this. Thus, it needs further research to strengthen its generalizability, whether in other conflicts or with other actors. Second, during this research I was not able to find any direct theories that tried to explain the use of drones or to compare the use between actors, state and/or non-states. Therefore, I had to adapt from a proliferation theory. It means that the results of this essay need to be further studied, or to develop the actual theory adaptation, or to strengthen the actual use of it, i.e., this thesis suggests conducting similar case studies to develop the theoretical framework and make the indicators that translate the use of UAS more accurate and parsimonious. There is also significant variation between non-state actors (or states) that might be worth studying in their own right. Quantitative studies are encouraged to determine whether the findings hold generalizability or if they are unique to cases similar to those studied here.

Finally, the environment in which air warfare is being waged is changing fast with the innovations that the UAS bring. Current studies make predictions, counting on what this technology will offer with few present examples. But some innovations are already happening, mainly with NSAGs, that are boundless and have to count with creativity to be effective. Thus, this field of research is worthy of further academic research.

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