Adaptation and Innovation: Commercial Drones in Myanmar's Emerging Armed Conflict Dynamics

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TO ALL YOUTHS FROM MYANMAR!

Abstract

This study explores the impact of drone technology on the conflict dynamics in Myanmar following the military coup in February 2021. As resistance groups and Ethnic-Armed Organizations increasingly adopt commercial drones for reconnaissance and offensive operations, this research examines how these technologies influence tactics, strategies, and social organisation. Guided by the diffusion of innovation, adoption capacity, and interest-based theory, the study employs process tracing to analyse the causal mechanisms behind drone adoption.

Three hypotheses are tested: (1) drone adoption is driven by cost-effectiveness, accessibility, and perceived technical advantages; (2) technological advancements and operational needs influence the shift to offensive drone use; and (3) the transition to in-house drone production is supported by networks of technical experts and financial backers. The findings reveal regional differences in drone use and highlight the significant impact on the asymmetry of warfare. This research contributes to understanding dual-use technology in conflict, specifically focusing on Southeast Asia.

Keywords: Commercial Drones, Resistance Groups, Myanmar, Conflict.

Disclaimer

The views and opinions expressed in this dissertation are solely those of the author and are not necessarily represent any organisation. Any content provided by the author is of their opinion and is not intended to malign any organisation, company, individual, or entity.

Table of Contents

1 Introduction

1.1 Background of Research

In February 2021, Myanmar witnessed a military coup that led to widespread human rights violations and brutal crackdowns on protests (HRW, 2021). This repression drove many, especially youth, to take up arms (Thant, 2021). By May 2021, more than 300 anti-resistance groups had emerged nationwide (Hein, 2022b). The following conflict has been marked by its asymmetrical nature, with the Myanmar military holding significant resource superiority (Hein, 2022a). However, a new dynamic has emerged in this conflict: the adoption of technology by resistance forces. Young technophiles began exploring the use of drones as a tool to challenge the Myanmar military's dominance, signalling a shift in the tactics and strategies employed by the resistance.

1.2 Research Problem and Significance of the Research

Starting in 2023, analysts and observers of Myanmar's conflict began to highlight the use of commercial drones by resistance forces (Oo and Sin, 2023; Sin, 2023, 2024). Their work has shed light on how drones are being utilised and the effectiveness of these deployments. However, a significant gap in the literature remains—the impact of drone adoption on the strategy and social organisation of armed groups. The significance of this research lies in its aim to understand how the evolving use of dual-use technology is shaping the conflict dynamics in Myanmar.

1.3 Research Question and Hypothesis

To explore the evolving dynamics of drone use in Myanmar's conflict, this study is guided by the central research question: "How does the use of drones influence the tactics, strategy, and social organisation of resistance group drone wings?" This question aims to uncover the tactical and strategic impacts of drone technology and how it reshapes these groups' internal structure and operational dynamics. The research is structured around three key hypotheses:

1. **Adoption Hypothesis:** The decision of newly formed armed groups to adopt commercial drones is influenced by factors such as cost-effectiveness, accessibility, and perceived technical advantage compared to traditional weaponry.

2. **Tactical Shift Hypothesis:** The shift in drone usage from reconnaissance to offensive operations is driven by technological advancements, increased tactical needs, and the evolving dynamics of the conflict.

3. **Production and Modification Hypothesis:** The transition from reliance on commercial drones to in-house production is facilitated by developing a complex network involving technical experts, financial backers, and logistical support.

Interviews and open-source data collection test the above hypotheses and provide a comprehensive understanding of drones' role in the current conflict and their broader implications for strategy and organisational dynamics.

1.4 Theoretical Framework and Method of Analysis

The theoretical framework of this study is grounded in several key theoretical approaches: diffusion of innovation theory, adoption capacity theory, and interest-based theory. The diffusion of innovation theory helps explain how and why resistance groups adopt new technologies, such as drones(Gilli and Gilli, 2016). Adoption capacity theory sheds light on the factors that influence the ability of these groups to integrate drone technology into their operations effectively (Gilli and Gilli, 2014). Finally, interest-based theory, as discussed in the literature, provides insights into the motivations, challenges, and implications of drone adoption by non-state actors (Balkan, 2019).

Building on this theoretical framework, the study employs process tracing as its principal methodology. This approach is used to understand the causal inferences and mechanisms that drive the sequence of events, particularly about the adoption and deployment of drones in Myanmar's conflict (Mahoney, 2015). Process tracing allows for a detailed examination of the cause-and-effect relationships, helping to uncover the underlying factors that have shaped the current dynamics of drone use in this context (Lyall, 2014).

1.5 Thesis Outline

This section provides the background and significance of the study, introduces the research question and hypotheses, and outlines the theoretical framework and methodology used in the research.

Chapter 2 explores the theoretical and conceptual frameworks related to war and peace dynamics, the social organisation of non-state actors, including rebel economies and

governance, and theories surrounding the use of drones by non-state actors. This chapter also reviews previous case studies on drone use, offering a foundation for understanding the current context in Myanmar. Chapter 3 details the data collection and analysis methods employed in the study. It explains process tracing as a methodology to understand the causal mechanisms and sequences of events in the adoption and deployment of drones by resistance forces in Myanmar.

The first set of empirical findings focuses on the use of commercial drones in Myanmar. Chapter 4 traces the evolution of drone adoption, examining how and why drones became an integral part of the resistance forces' strategy and operations.

Chapter 5 analyses the differences in drone use across various regions of Myanmar, highlighting the challenges associated with drone adoption. This chapter explores how these challenges impact the social organisation of drone units, fundraising activities, and popular support. It also considers the broader implications of these differences, particularly in the context of the conflict's evolving dynamics.

Chapter 6 discusses the broader implications of drone use in Myanmar, focusing on the involvement of multiple actors, including the Myanmar military, with the help of foreign technical support. The chapter examines how the sophisticated use of drones by long-established organisations, as well as newly formed armed resistance forces, is reshaping the conflict landscape and potentially altering the dynamics of armed conflict in the region.

2 Literature Review

This chapter comprises two main sections: first, understanding the complex and multidimensional nature of war, civil war and conflict and second, the deployment of drones by non-state actors in the conflict.

2.1. Conceptualisation of War and Conflict

While reviewing the case studies on the conflict in Myanmar, scholars have mostly looked into the role of the Myanmar military (Tatmadaw or Myanmar Armed Forces)[1] as a main character (Callahan, 2005; Myoe, 2009) and the efforts for a ceasefire with armed groups in ethnic areas. Scholars have included the role of society and religion in policymaking, and many have argued that society and their practice of religion have long affected the conflict in Myanmar (Hlaing, 2014). Except for scholars like Gerad McCarthy, little has addressed the perspective of conflict dynamics, such as economic and social order (McCarthy and Farrelly, 2020). Since this research tries to understand the process of drone adoption, including the enquiries into the economic requirements of armed groups in acquiring drones, literature reviews look into the dynamics of conflicts and social order.

2.1.1. The War/Peace Binary and Social Order

While policy reports and academic literature note the conflict between Myanmar Armed Forces and ethnic armed groups as an armed struggle or armed conflict, journalistic reports have frequently mentioned it as a civil war, starting from the year of independence in 1948 (Myoe, 2009; Latt *et al.*, 2018). As the first step of the literature review, the research looked into the views of war, peace, and small wars and found Tarak Barkawi's work interesting and worth noting here to support the conceptual understanding. Barkawi challenged the traditional view of war and peace as distinct and mutually exclusive states by highlighting the interplay of force, war, and politics in shaping societies, extending beyond state actors to include ethnic groups and other entities (Barkawi, 2016). His notes emphasise

[1] Before the dialogue for the nationwide ceasefire agreement started in 2011, the narrative for ethnic armed groups was an ethnic insurgency. They officially adopted ethnic armed organisations (EAO) in the Nationwide Ceasefire Agreement (NCA). After the military coup, the groups started using Ethnic Revolutionary Groups (ERO) because the former term EAO was enshrined in NCA, which is no longer valid after the military coup in 2021. I used EAO or EAG to describe events before the coup in 2021 and ERO for the events after 2021.

how war can create and sustain social orders rather than simply disrupting or destroying them.

The hierarchical structure of world politics and the interconnectedness of this hierarchy with the international system of states are complex; however, the interdependence of war and society is ignored. **Barkawi** (2016) pointed out the often-overlooked impact on world politics and society by drawing attention to the concept of the 'Small Wars,' which makes the readers realise how the imperial and small wars have significantly shaped societies globally, particularly in the North and South. The importance and implications of small wars and their associated violence are rarely considered in social and political studies. Barkawi also suggests the need to pay more attention to the role of non-state actors in shaping the international system.

Barkawi (2016) critiques the dominant "trinitarian" model that views politics, the people, and force as territorially bound within the nation-state. He advocates for a broader understanding encompassing various actors and their complex relationships in conflict settings. He highlights that while the traditional idea of power is embodied in the sovereign state and its national armed forces, the same logic applies to other groups, such as ethnic groups or movements seeking national liberation or secession (Barkawi, 2016). In these entities, politics, the people, and the use of force are intertwined and seen as being connected to a specific territory. This connection is also seen as socially equivalent or similar.

Mary Kaldor presents another dimension of social order by distinguishing between 'new wars' and 'old wars' (2012). In this globalisation, state fragmentation, low participation, and violence gainst civilians characterise the former and traditional interstate conflicts. By introducing 'new wars', she explores the changing nature of warfare and its impact on economies and societies (Kaldor, 2012). Showcasing the cases studies of fragmentation and decentralisation of the state, she argues that participation is relatively low to the population due to the lack of legitimacy on both sides of warring parties and limited economy, which leads the scenarios of the war highly depends on local predation and external support (Kaldor, 2012, p. 94). Mary terms the new wars as 'globalised war' for conditions and scenarios. On the other hand, the old wars were characterised by a clear distinction between combatants and non-combatants, with battles being the primary form of violence. The war effort was largely financed through domestic production and taxation, and

cooperation between warring factions was rare (Kaldor, 2012). Kaldor's work lead to the deep examination of actors involved in conflict - non-state armed groups, state actors and humanitarian agencies. The following section presents how scholars have tried to conceptualise those actors.

2.1.2. Actors in Conflict

Traditionally, in a conflict setting, studies focus on the role of state actors in providing security and delivering essential services to the civilian populations in warring zones (Kaldor, 2012; Arjona, 2016). The literature on the role of state actors in conflict, including their interactions with non-state armed groups and their impact on civilian populations, explores state power, legitimacy, and governance dynamics in conflict settings. Ong and Steinmueller stated in their studies on United Wa State Army (UWSA), the strongest ethic armed group in Myanmar, that state actors often struggle to maintain control and legitimacy in the face of challenges from non-state armed groups (2021, p. 66). In the scenario of losing control and legitimacy, state actors may resort to repressive measures to suppress dissent and maintain order, which can further exacerbate conflict and lead to human rights abuses.

Studies on non-state armed groups examine the motivations, strategies, and those groups' impact in conflict settings. In Bakke's study on Reble Rulers (2012), non-state armed groups are economically self-interested, pursuing short-term economic payoffs sometimes while they are not politically ideological and with the potential to gain control in weak or collapsed states (Marten 1006, p. 7; Hobsbawm, 1990). Ong and Steinmueller have recently challenged Paul Collier's "greed vs. grievance" models by pointing out the complex structure that drives the group's actions (2020, p. 68). Ong and Steinmueller critique 'greed and grievance' models as overly focused on non-state armed groups' activities such as predation, extortion, and smuggling to finance their operations (2020, p. 68). Kaldore (2012) highlighted those groups' reliance on external assistance, such as remittances from abroad, support from the diaspora, and humanitarian aid (2012, p. 197-108). The impact of non-state armed groups on society can be significant, leading to displacement, human rights abuses, and the breakdown of social order

Ong and Steinmueller acknowledge the presence and role of humanitarian agencies in contemporary conflicts in their finding (2020, p. 69). They touch upon the complex relationship between humanitarian aid and conflict dynamics, including funding, access, and neutrality issues. Humanitarian agencies play a crucial role in assisting populations affected by conflict. However, their operations are often constrained by security concerns, political interference, and limited resources. Gilles Carbonnier also raises questions about the unintended consequences of humanitarian aid, such as prolonging conflict or inadvertently benefiting armed groups (Di Cosmo, Fassin and Pinaud, 2021).

2.1.3. Dynamics of Conflict

This section explores the literature primarily focusing on conflict dynamics, encompassing the intricacies of war economy, civilian resistance, social order, and the adaptive strategies employed by non-state armed organisations.

Bakke, Kaldor and Di Cosmo look into the economic aspects of conflict, exploring how different actors finance their operations and the impact of conflict on local economies (2012; 2012; 2021). As stated in the non-state actors sub-section, Kaldore highlights the diverse funding sources, including external assistance, resource extraction, and predation. A collapse in domestic production, a reliance on outside assistance and local predation, and the privatisation of military forces are characteristics of the war economy in new wars (2012, p. 96). As the fighting units in these conflicts are small-scale in character and lack the hierarchy and order of traditional guerrilla forces (2012, p. 97). In terms of warfare, they rely on small arms and light weapons and engage in activities such as extortion, smuggling, and the control of checkpoints to generate revenue (Kaldor, 2012; Di Cosmo et al., 2019).

Another dynamic of conflict is civilian resistance and social order. As mentioned in the social order section, Barkawi argued that civilian populations in conflict settings either accept or resist armed groups and try to maintain social order (Barkawi, 2016, p. 206). In her studies on the conflict in Colombia, Arjona explores the mutually inclusive notion between civilians and combatants and the factors influencing civilian agency and resilience in wartime (Arjona, 2016, p. 100). Arjonoa develops two conceptual notions, called 'rebelocracy' and ‘idiocracy’, to explain different forms of wartime social order that can

emerge (2016, p. 102). According to her, Rebelocracy occurs when armed groups exert extensive control over civilian life, and aliocracies are when their intervention is limited to public order and taxation. Arjoina points out that the level of civilian resistance and the institutional arrangements in place can significantly shape social order in conflict zones.

Last but not least, **organisational adaptation** is the third dynamic. Parkinson discusses how non-state armed groups adapt their organisational structures and strategies in response to external pressures and challenges (Parkinson, 2023). The study highlights the importance of understanding these adaptive processes to effectively analyse and respond to the evolving tactics of these groups. Parkinson's work introduces three levels of organisational adaptation - repurposing, remapping and adapting (2023). First, non-state armed groups often repurpose when they use everyday communications and relationships to reroute communications and resources by altering their fundamental organisational structure. Second, remapping, is when adaptations become systematic across the organisation. Remapping is routinised and institutionalised, in other words, systematic adaptation across the organisation. Third, the adaptive process emerges when new rules, skills, and practices are incorporated into network ties, leading to new understandings of collective membership and goals (Padgett and McLean, 2006; Padgett and Powell, 2012; Obert 2014, 2018; R. Gould, 1995).

2.2. Literature on the use of Drones

Literature on strategic studies has offered significant insights into drones' impact, mainly through technological determinism approaches (Dafoe, 2015). These approaches posit that technology, rather than social or political factors, drives development and innovation in weaponry (Dafoe, 2015). While this concept has been contested, its relevance persists in military discourse, notably in discussions of revolutions in military affairs (Walton, 2019). Some scholars suggest that economic and military competition may further create sociotechnical evolution within deterministic pathways (Dafoe, 2015).

The deployment of drones in warfare has ignited debates surrounding technological determinism and its ethical ramifications. Drones have revolutionised combat, enabling unprecedented battlefield surveillance and control over combat efficiency (Korac, 2023).

However, this technological advancement has also raised concerns about increased domination and intrusive monitoring of troops (Korac, 2023). The escalating use of armed drones by the U.S. military has prompted ethical questions regarding asymmetrical risks in warfare (Schulzke, 2019). Critics fear that by minimising casualties, drones may distort public perceptions of war, potentially undermining democratic accountability and encouraging military interventions (Schulzke, 2019).

The above discussion and critiques are based on the notion of military-graded drones developed by state actors. Debate on the use of drones by non-state actors, especially terrorist organisations, emerged as early as 2000 (Ronfeldt and Arquilla, 2000) and received attention in the policy and academic cycle in the early 2010s (Ackerman, 2011; Choi-Fitzpatrick, 2014; Long, 2014; *Christian et al.*, 2014; Sayler, 2015; West, 2015). The utilisation of drones by non-state actors has become increasingly widespread, particularly in conflict zones across the Middle East, Central Asia, and beyond (Haugstvedt, 2023).

While military-grade drones remain inaccessible, these groups often modify consumer drones for weaponisation, creating "killer bees" capable of inflicting significant damage (Braun and Fleiss, 2021). This adaptation has fostered a cyclical process of learning and counter-learning between state and non-state actors, as observed in the conflict in Ukraine in 2014 (Haugstvedt, 2023). Boyle (2020) stated that armed drones empower non-state actors to challenge state aerial dominance and expand their operational capabilities. These groups leverage drones for various purposes, including surveillance, propaganda, and targeted attacks (Chávez and Swed, 2023). Notably, the adoption of drone technology is often influenced by network affiliations and sponsorship; for example, Iran plays a prominent role in providing drones for nonstate actors in its neighbouring region (Chávez and Swed, 2023). Due to the complex and intricate network arising from the adoption of drones, Boyle highlighted the scenario of the growing threat to both military and civilian targets from the proliferation of drone technology among non-state actors (2020).

Since the focus of this research is to examine the use of commercial drones by the resistance forces against the Myanmar Armed Forces (MAF), the project reviewed the literature on the adaptation of commercial drones on the battlefield by non-state actors. As the deployment of commercial drones by resistance forces in Myanmar is a new case study, the research first looked at the use of commercial drones in an insurgency setting. While the

conceptual distinction between insurgency and terrorism, their shared characteristics as non-state actors against more powerful and resourceful state actors made the existing literature address their adoption of drones through similar theoretical frameworks due to shared characteristics, such as facing asymmetric warfare and the availability of dual-use technology.

This chapter explores five main parts: 1) theoretical approaches for non-state actors' adoption of drones in combat, 2) motivation behind the adoption of commercial drones, 3) types of drones and their uses, 4) Implications and Debates on the Use of Drones by Non-State Armed Groups, and 5) Additional Considerations.

2.2.1. Theoretical Approaches on Non-State Actors' Use of Drones.

While some academics explained the phenomenon from the traditional conceptual framework of military innovations (Rossiter, 2018), some solved the puzzle from the business management models (Fuhrmann and Horowitz, 2017; Gilli and Gilli, 2016). Studies have presented four theoretical explanations so far. First, from the military innovation perspective, the diffusion of innovation theory can support the studies of determinants for adopting technology (Gilli and Gilli, 2016). Second, based on the innovation theory, the adoption capacity theory bridged the gap in the literature on how actors and agencies facilitate the shift (Fuhrmann and Horowitz, 2017). Interest-based theory is the third one that supports the study of strategic and political objectives behind technological adoption (Gilli and Gilli, 2016). Finally, supply-side arguments discussed an organisation's capacity, highlighting the limited availability of resources (Gilli and Gilli, 2016).

i. Diffusion of Innovation (DOI) Theory

Tracking the origin of the theory, the research finds that E.M. Rogers developed in 1962, aiming to understand the processes involved in the spread of new technologies and ideas and the factors influencing the rate and time of adoption among different groups (Gilli and Gilli, 2016). Scholars in the fields of business and international security studies with a focus on the development of military technology tried to explain the process of the diffusion

of innovation. Their efforts were long enough to develop a framework to examine where the diffusion process is related to an innovation or ideational motivation for creation (Rossiter, 2018). The diffusion of innovation theory supports understanding what best accounts for the variation in the rate and time of adoption among organisations (Rossiter, 2018, p. 115).

Regarding the adoption of drones, DOI supports explaining how and why non-state actors adopt and utilise drone technology and the variations in how quickly and extensively different groups embrace this new tool (Gilli and Gilli, 2016; Rossiter, 2018). The theory emphasises the understanding of the needs, goals, and capabilities of the end-users of the technology (2016; 2018). It argues against technological determinism, which suggests that technology alone shapes its adoption and use (Dafoe, 2015; Walton, 2019). Therefore, Rossiter stated that the adoption of drones by militant groups is not solely determined by the technology itself but also by the groups' needs, goals, and capabilities (2018). Understanding what potential users hope to achieve can provide insights into their adoption and use of drones.

Studies on drone adoption by ideologically driven non-state groups, whose values and motivations differ from those of states, use this theory due to its relevancy in analysis. Rossiter (2018) implied that those groups might prioritise advancing their ideological agenda or organisational goals, even at the cost of military losses, which can influence their choice of tools and technologies. The existing commentary on drone usage by militant groups often focuses on future implications rather than present realities. The literature has suggested that understanding the motivations and goals of these groups can provide a more refined perspective on their current and future drone use. Scholars also point out that misconceptions about how jihadi groups use technology have led to an overemphasis on sensational aspects of their online activity and neglect of more routine uses.

ii. **Adoption Capacity Theory (ACT)**

Adoption Capacity Theory (ACT) looks into the requirements for successfully adopting innovation and an organisation's ability to fulfil those requirements (Rossiter, 2018; Ali, Kaur and Khan, 2023). It considers a multidimensional approach of extensive cost, organisational resources, and the innovation's perceived tactical or strategic benefits.

Rossiter (2018) elaborates that ACT emphasises the need assessment for an organisation to adopt an innovation and its capacity, particularly its resources, to meet those requirements. If the innovation is financially burdensome, groups with limited resources may struggle to achieve their desired adoption level. Even with available resources, adoption can be hindered by organisational resistance to the changes the innovation might necessitate.

ACT literature emphasises two key factors influencing the capacity to adopt military innovation:

1. Financial intensity: The financial resources required to acquire and implement the innovation (Gilli and Gilli, 2014, 2016, 2018).

2. Organisational capital: The extent to which the innovation necessitates adjustments to the organisation's structure, processes, and culture (Horowitz, 2017).

The theory further categorises innovations into two types: sustaining and disruptive innovations (Gilli and Gilli, 2014). Sustaining innovations are incremental improvements to existing technologies that do not pose significant organisational challenges. Disruptive Innovations are paradigm-shifting innovations that often require substantial organisational changes. ACT posits that only organisations with high organisational capital (i.e., greater flexibility and adaptability) are likely to adopt such innovations successfully (Gilli and Gilli, 2014, p. 524).

In the context of drone adoption by non-state actors, ACT suggests that commercially available drones' relative affordability and user-friendliness make them accessible even to groups with limited resources and organisational capacity. Conversely, adopting more sophisticated military-grade drones may need to be improved because of their high cost and the need for significant organisational restructuring to operate and maintain them effectively. While financial intensity and organisational capital are vital considerations, other scholars contend that an innovation's perceived tactical or strategic benefit is the primary driver of its adoption (Rossiter, 2018, p. 115). This perspective suggests that even resource-constrained organisations may be motivated to adopt an innovation if it promises significant advantages in their operational context.

iii. Interest-Based Theories

The literature discusses **interest-based theories** primarily in the context of state actors. Still, their principles can also be extended to understand the motivations of non-state actors in adopting drone technology. The main idea behind these theories is that adopting technologies like drones is driven by pursuing specific interests or objectives.

They focus on states as actors. Fuhrmann and Horowitz (2017) state that "interest-based theories suggest that states adopt technologies or policies to meet critical strategic or political objectives. States will develop UAV technology when they face security threats, according to interest-based arguments in the UAV case (2017, p. 4). This is particularly true in cases of high levels of terrorism and border disputes with neighbouring countries. Fuhrmann and Horowitz (2017) further elaborate that the domestic political institutions of a state can also influence its incentives to acquire drones. For instance, UAVEs might favour democracies due to their preference for capital-intensive militaries and a desire to minimise human casualties. On the other hand, autocracies might seek UAVs to counter insurgencies or suppress domestic political opposition effectively.

While their study primarily focuses on state actors, the underlying principles of interest-based theories can also be applied to non-state actors. These groups may adopt drone technology to further their own strategic or political objectives, such as conducting surveillance on adversaries, launching attacks, or spreading propaganda (Rossiter, 2018; Ball, 2017; Gill et al., 2013; Boyle, 2020; Chavez and Swed, 2021; Kunertova, 2023). The specific interests and objectives driving drone adoption will likely vary depending on the group's ideology, goals, and the context in which they operate.

iv. Supply-Side Arguments

While interest-based theories focus on the motivations and objectives driving drone adoption, supply-side arguments emphasise the constraints imposed by organisational and financial limitations (Rogers and Kunertova, 2022). The availability and affordability of different types of drones can influence the choices of state and non-state actors. The supply-side arguments in the context of drone adoption emphasise that the limitations and difficulties associated with the technology's supply side significantly impact the ability of

states or non-state actors to acquire and use drones (Chávez and Swed, 2021, p. 3). The literature highlights three critical aspects of these supply-side arguments - organisational and financial constraints, technological capacity and the role of civilian and commercial drones.

First, developing, producing, and operating advanced drone systems requires substantial organisational capabilities and financial resources (Chávez and Swed, 2021, p. 3). The design and manufacturing of these systems necessitate specialised laboratories, testing facilities, production capabilities, and technical expertise, which can be a significant barrier for many actors. Even for military-graded drones, the costs and complex organisational requirements associated with advanced drone systems can limit their accessibility to only those actors with sufficient resources and capabilities. (Fuhrmann and Horowitz, 2017; Gilli and Gilli, 2016)

Second, a state or group's technological capacity is crucial in determining the types of drones it can acquire and operate (Fuhrmann and Horowitz, 2017, p. 2). The ability to maintain, repair, and upgrade these systems also necessitates technical expertise and infrastructure. An actor's technological capacity can significantly influence their ability to use drone technology effectively for their intended purposes. (Fuhrmann and Horowitz, 2017; Gilli and Gilli, 2016; Chavez and Swed, 2021)

Third, the emergence of commercially available off-the-shelf (COTS) drones has significantly altered the supply-side dynamics of drone technology (Swed, 2020). These drones are readily available, inexpensive, and user-friendly, making them accessible to a broader range of actors, including non-state groups with limited resources and technical expertise (Swed, 2020). The increasing sophistication and capabilities of COTS drones further enhance their appeal and potential applications. The availability of COTS drones has lowered the barriers to entry for acquiring and utilising drone technology, challenging the traditional supply-side constraints associated with military-grade systems. (Jackman, 2019; Chavez and Swed, 2021)

2.2.2. Why Do Non-State Actors Use Drones?

Records indicate the long history of the non-state actors' adoption of drones can be political, such as an attempt to assassinate Venezuela's President Maduro with a drone attack

in 2018 (BBC World News, 2018) and an event of flying drone with radiated materials over government compound in Japan (BBC World News, 2015), or military motive by deploying drones as an offensive tool in the battlefield or harassing their adversaries. In the latter case, Hezbollah employed an unmanned aircraft for surveillance as early as 2004 (Rossiter, 2018; Boyle, 2020). However, the literature suggests that the utilisation of drones by these groups gained significant momentum around 2014 (Boyle *et al.*, 2017). Off several key events, analysts highlighted three – first, the militants' drone usage in Iraq in 2015, which is recorded as the first government report (Rossiter, 2018); second, the Islamic State's drone capabilities and evolution from surveillance in 2014 to upgraded reconnaissance and propaganda purpose in 2015 (Boyle, 2015) and the conflict in Ukraine, commenced in 2014, where both sides leverage drones for a variety of purposes (Boyle, 2020).

Before inquiring about why non-state actors use drones, there are two main things to consider: how they use drones. First, technological accessibility and economic viability play a central role in driving non-state actors' adoption of drones, their multipurpose usage, and their cultural and social implications. Rossiter (2018) highlighted an attempt with technology to narrow or bridge the capability gaps with conventional military forces and noted that such an attempt is essential in understanding why non-state actors have eyes on drones, regardless of their grade. Commercially available drones, such as quadcopters for aerial photography and agricultural drones, can be used for multiple purposes, including monitoring and delivery. Analysts and observers have well-documented drones' multifunctional capabilities and discussed how low-cost, non-military-grade drones can be fitted for reconnaissance and deployed in direct combat by improvised weaponisation (Jackman, 2019).

Integration of unmanned aerial vehicle (UAV) technology into warfare has significant cultural and social implications, as claimed by Choi-Fitzpatrick (2014), with the scenarios of how drones can alter the dynamics of public and private spaces by shifting surveillance from the streets to the skies . Cronin (2020) opened this discussion by linking the increase in drone use with other emerging technologies like 3D printing and robotics, suggesting a convergence that enhances the destructive reach of non-state actors. According to Cronin (2020), this combination shifts power dynamics and escalates the potential for violence in non-traditional warfare settings (2020).

Secondly, economic considerations such as availability and affordability to acquire drones have become favourable options for non-state actors to adopt drones. Chavez and Swed (2021) added that the cost of commercial drones is economically affordable and easy to use, and this affordability attracts groups with significant resource constraints. In the market, the price of a small hobbyist drone starts from USD 300 and, in some cases, is lower than that. Cronin (2020) assumed that the affordability and replaceability of drones enable non-state actors to engage in a war of economic attrition against even the most advanced military forces. However, their studies are incomplete in their description or explanation of the nature of resource constraints—the availability of funding or the economy of those non-state armed groups. In addition, the existing studies are blind to whether those groups can continue drone adoption.

To return to the primary inquiry of why non-state actors adopt drones, the nature of their warfare and the availability of resources to counter their adversaries, typically states with greater power and resources, are crucial. Undeniably, the nature of conflict or power contestation between state and non-state actors has always been asymmetric; these latter actors have found drones efficient in levelling the playing field and enhancing their operational capabilities. The multi-purpose nature of drones, serving as reconnaissance tools, explosive carriers, and delivery mechanisms, further encourages them to use drones.

i. Asymmetrical Warfare & Resource Constraints

Non-state armed groups often find themselves at a technological disadvantage compared to state actors, leading them to adopt asymmetric warfare tactics. Wallace and Reeves (2013) stated that this asymmetry drives these groups to seek innovative solutions to level the playing field, and drones have emerged as a particularly effective tool. Unmanned aerial vehicles offer a unique advantage for non-state actors engaged in asymmetric warfare (Ball, 2017). They provide aerial capabilities without extensive infrastructure, making them adaptable to diverse operational contexts. Ball (2017) also suggested that while currently a niche threat due to limited sophistication, drones are likely to become increasingly integrated into the combat operations of non-state actors for both non-lethal and lethal purposes.

While the proliferation of drones among non-state actors is a significant development, it is important to note that state actors still play a substantial role in disseminating weapons to these groups (Long, 2014). This complex interplay between state and non-state actors in the arms trade adds another layer to the evolving landscape of modern warfare.

ii. Levelling the Playing Field

Boyle (2020) suggested that drones have the potential to alter the power dynamics in conflict by enabling non-state actors to challenge the state's dominance in the sky and also alter the risk calculations on both sides. Traditionally, non-state actors could not challenge state air superiority (Boyle, 2020). Drones enable these groups to take to the skies, introducing new vulnerabilities for ground troops and forcing a reassessment of military strategies (Boyle, 2020). Boyle gave an example through a case study of the United States' use of drones for targeted killings in regions like Yemen, exposing American troops to similar risks in other theatres (2020). Non-state actors' rapid drone technology adoption and adaptation further underscore this levelling effect. Boyle (2020) cites the Islamic State's swift progression from basic surveillance to proficient reconnaissance and propaganda as a prime example. This evolution has empowered these groups to challenge powerful governments, potentially expanding their strategic goals (Boyle, 2020).

However, the ultimate impact of drone access for non-state actors remains uncertain. Whether drones will fundamentally alter the goals of these organisations or significantly change the outcomes of asymmetric conflicts is yet to be seen. Boyle (2020) highlights the stark power imbalances that often characterise these conflicts, suggesting that while drones may not completely level the playing field, they can introduce new vulnerabilities for more powerful actors. While not a universal game-changer, drones have the most significant impact in conflicts where power asymmetry is relatively minor (Boyle, 2020). In these scenarios, even small commercial drones used for reconnaissance can significantly reduce the advantages of more powerful adversaries.

iii. Expansion of Operational Capabilities

Chávez and Swed (2021) presented drone use in three levels: strategic, operational, and tactical. At the strategic level, drones serve as tools for propaganda. In contrast, at the operational and tactical levels, they facilitate intelligence gathering, target acquisition, and even direct attacks, thus enhancing the military reach of NSAs with reduced risk and cost (Chavez & Swed, 2021). Their study notes that non-state actors employ drones for various strategies, including attrition, intimidation, provocation, and spoiling. At the tactical level, civilian drones extend the reach of violent non-state actors (VNSAs), penetrate defence systems, and are used for weaponised attacks (Chávez & Swed, 2021).

The proliferation of drones has expanded the operational capabilities of both state and non-state actors. For non-state actors, drones offer a way to challenge state dominance and exert influence in various conflict contexts (Horowitz et al., 2016). These consequences are particularly significant in counterterrorism operations and domestic control within authoritarian regimes (Horowitz et al., 2016). As Boyle (2016) suggests, the race for drone technology is reshaping global competition and altering the dynamics of long-standing conflicts.

However, Horowitz et al. (2016) caution against overstating the impact of drones, particularly in interstate conflicts. They argue that the policy of targeted killing, rather than the technology itself, is the more influential factor. Additionally, they emphasise that drones have limitations, such as vulnerability to air defence systems, the potential for hacking or jamming, and the lack of air-to-air capabilities (Horowitz et al., 2016).

Despite these limitations, drones offer significant advantages in specific operational contexts. For instance, they excel in permissive airspace where the risk of being shot down is low (Horowitz et al., 2016). Moreover, drones provide sustained surveillance capabilities and reduce the diplomatic fallout of using force (Horowitz et al., 2016). While drones offer unique advantages, their operational effectiveness is context-dependent. Horowitz et al. (2016) argue that drones are most useful in intrastate conflicts where insurgents or terrorists are less likely to possess sophisticated air defence systems.

2.2.3. **The Functions and Types of Drones**

Drones perform various functions, all of which contribute to their evolving applications. Intelligence, surveillance, and reconnaissance (ISR) are critical functions, as are combat operations, loitering attack munitions (LAMs), propaganda and information operations, logistics and transportation, search and rescue, agriculture, infrastructure inspection, environmental monitoring, and commercial and recreational activities.

There are two primary types that non-state actors favour: commercially available off-the-shelf (COTS) drones and unmanned combat aerial vehicles (UCAVs). COTS drones are readily available and used by various actors for various purposes (Abbott *et al.*, 2016). They are relatively inexpensive, user-friendly, and require minimal technical expertise to operate. The accessibility and versatility of COTS drones have contributed to their widespread adoption and diverse applications. (Jackman, 2019; Chavez and Swed, 2021). COTS drones can be observed in the following civilian applications:

- **Agriculture:** monitoring crops, spraying pesticides, and assessing agricultural land.
- **Infrastructure Inspection**: Inspecting critical infrastructure, such as bridges, power lines, and pipelines.
- **Environmental Monitoring**: Collecting data on environmental conditions and wildlife populations.
- **Commercial and Recreational Purposes**: include photography, videography, and other recreational activities.

UCAVs are advanced military drones equipped for combat operations. They are equipped with advanced weaponry and targeting systems, enabling them to conduct precision strikes and engage in aerial combat. UCAVs are typically larger and more expensive and require significant technical expertise and infrastructure to operate and maintain. Their use is primarily limited to state actors with substantial military capabilities (Gilli and Gilli, 2016).

Other types of drones deployed in the conflict include first-person view (FPV), one-way attack, and swarming drones. Each type has distinct capabilities and applications (Ronfeldt and Arquilla, 2000).

- **First-Person View (FPV) Drones**: For FPV types of drones, a pilot controls remotely, wearing a headset that displays a live video feed from the drone's camera, providing an immersive flying experience (Gettinger, 2020). FPV drones are often used for racing and other recreational activities but have also been adapted for military and other purposes.

- **One-Way Attack Drones**: These are drones designed for a single attack mission. They carry explosives and impact the target to detonate (Gettinger, 2020). They are often used when retrieving the drone is not feasible or desirable.

- **Swarming Drones** are multiple drones operating together as a coordinated unit, often controlled by a single operator or autonomous algorithms (Balkan, 2019). They offer advantages in terms of flexibility, adaptability, and resilience and have the potential to disrupt traditional military tactics and strategies.

Drones' various functions and types demonstrate their versatility and adaptability across multiple domains. As drone technology evolves, new applications and functions will likely emerge, further expanding their impact on society and security. The following presents the functions of drones seen in the combat field and a small assessment of their strengths and weaknesses.

Intelligence, Surveillance, and Reconnaissance (ISR) are two of the first functions detected from drone deployment (Balkan, 2019). Some literature states that Hams deployed drones for ISR purposes in the 1990s. Using drones for ISR purposes has become increasingly prevalent, enabling the collection of real-time intelligence (gathering information) and enhancing situational awareness (monitoring) (*Christian Science Monitor*, 2014). ISR drones have various sensors and cameras to collect data and provide real-time situational awareness. The ability of drones to gather information and monitor activities from a distance offers significant advantages in various contexts, including military operations, border security, and disaster response (Balkan, 2019). The literature emphasises the role of ISR drones in providing critical information for decision-making and facilitating targeted missions (Gilli and Gilli, 2016; Chavez and Swed, 2021).

The second function can be seen in combat operations, mostly classified as military-graded ones and produced by state actors (Balkan, 2019). Using drones in

combat operations has changed the nature of enabling precision strikes while reducing risks to human combatants. Unmanned Combat Aerial Vehicles (UCAVs) are designed for combat missions and are equipped with advanced weaponry and targeting systems. The use of UCAVs has sparked debates on the ethical and legal implications of remote warfare and the potential for increased civilian casualties. (Gilli and Gilli, 2016; Boyle, 2020)

The third function is Loitering Attack Munitions (LAMs). LAMs represent a unique category of drones that combine surveillance and reconnaissance capabilities with the ability to strike adversary targets with precision (Gettinger, 2020). These drones can loiter in an area, gather information, and then engage a target when the opportunity arises. The dual functionality of LAMs blurs the lines between traditional categories of weapons and poses new challenges for defence and countermeasures. (Gilli and Gilli, 2016)

Fourth is for Propaganda and Information Operations: Drones have also been utilised for propaganda and information operations, enabling the dissemination of messages and imagery to influence public opinion and support (Boyle, 2020, p. 18). Non-state actors, in particular, have leveraged drones to showcase their capabilities and achievements, disseminate propaganda videos, and recruit new members. The use of drones for propaganda purposes highlights their potential impact on the information landscape and the challenges of countering their influence. (Boyle, 2020; Chavez and Swed, 2021).

In addition to the above functions, drones are also employed for various other purposes, including: **logistics and transportation to d**eliver supplies and equipment to remote or inaccessible areas; **search and rescue** to assist in disaster and crisis management (Chávez and Swed, 2021, p. 5). The diverse functions of drones highlight their versatility and adaptability across various domains. As drone technology evolves, new applications and functions will likely emerge, further expanding their impact on society and security.

2.2.4. Implications and Debates on the Use of drones by non-state armed groups

Asymmetric warfare is a commonly discussed dimension in studying non-state armed groups' drone adoption. Those groups often pose challenges to adversaries with superior resources by deploying innovative field tactics (Wallace and Reeves, 2013; Gilli and Gilli, 2014; Chavez and Swed, 2021). The availability and affordability of commercial off-the-shelf (COTS) drones have enabled those groups to conduct more effective

surveillance, launch attacks, and project force, potentially shifting traditional power dynamics in conflict zones.

However, the increased use of drones raises significant humanitarian concerns. The proliferation of drone technology raises concerns about misuse by terrorist groups (Long, 2014; Cronin, 2020; Boyle, 2020). According to arms control literature, these groups have the potential to disregard established laws of war, resulting in haphazard attacks and tragic consequences for civilians (Wallace and Reeves, 2013). Drones' dual-use nature, with applications in both civilian and military domains, complicates regulation and control, making it challenging to prevent their proliferation while maintaining legitimate uses (Schulzke, 2019).

Furthermore, the use of drones for targeted killings and surveillance by both state and non-state actors raises ethical and legal debates, particularly regarding the erosion of prohibitions on assassination and extrajudicial violence, the potential for human rights abuses, and the violation of international law (Boyle, 2020).

2.2.5. Additional Considerations

Three key aspects shape the complex landscape of drone adoption and utilisation by non-state actors. But these are not new phenomena. First is the rapid pace of technological advancement, which creates opportunities and challenges. Advancements in capabilities, such as increased flight time, payload capacity, and autonomous functions, significantly enhance their effectiveness for these actors (Horowitz et al., 2016; Cronin, 2020) while also challenging regulators and security forces to adapt their strategies to keep pace.

Non-state actors have proven remarkably resourceful in adapting drone technology to their needs, modifying commercial drones, developing innovative tactics and leveraging open-source platforms (Gill et al., 2013; Boyle, 2020). Their decentralised and adaptive nature facilitates experimentation and innovation, making it crucial to understand the motivations and organisational traits that drive this innovation to anticipate and counter their evolving tactics.

Furthermore, drones can threaten security dynamics in conflict zones and domestic settings because of their multipurpose functions, which challenge state authority and destabilise established power structures (Boyle, 2020; Kunertova, 2023). The unpredictable

and asymmetric nature of drone warfare demands innovative countermeasures and a comprehensive understanding of their impact to mitigate risks and maintain stability. Together, these factors underscore the need for ongoing research and analysis to navigate this evolving technology's complex challenges and opportunities.

3 Methodology

3.1 Introduction

The central research question that steers this investigation is: "How does the use of drones affect the tactics, strategy, and social organisation of resistance groups' drone wings?" The primary objective is to examine anti-junta resistance groups' paradigm shifts in weaponry usage. The research delves into how these groups have adopted and integrated drones into their strategies, focusing on the evolution of drone usage, technological adaptation and innovation, resource mobilisation, and organisational adaptation. Additionally, the project investigates how drone usage has impacted Myanmar's conflict dynamics.

The following hypotheses guide the research:

- **Hypothesis 1:** The decision of newly formed armed groups to adopt commercial drones is influenced by factors such as cost-effectiveness, accessibility, and perceived tactical advantages compared to traditional weaponry.
- **Hypothesis 2:** The shift in drone usage from reconnaissance to offensive operations is driven by a combination of factors, including technological advancements, increased operational needs, and the evolving dynamics of the conflict.
- **Hypothesis 3:** The transition from reliance on commercial drones to in-house production is facilitated by developing complex networks involving technical experts, financial availability, and logistical support.

This study employs a qualitative methodology encompassing process tracing, interviews, and social media analysis to address these research questions and hypotheses. The multi-layered approach will unpack the complex interplay between adopting and using commercial drones and the evolving tactics, strategies, and social organisation of resistance groups in Myanmar. It will thoroughly explain how these technological advancements shape, support, and challenge the country's armed conflict dynamics.

By systematically addressing the data collection and analysis methods, the research question can guide the formulation of clear and focused research questions that address the 'how' of drone adoption and usage by resistance forces (Newman and Gough, 2020). For data collection, the project is encouraged to gather information from multiple sources,

including open-source data for social media analysis. It also guides the structure of interviews and questionnaires, ensuring consistency and comparability across interviews. Butts and Roman (2011) highlighted various types of research that trade-off between precision and accessibility. They emphasised the importance of scientific inquiries and their role in formulating practical social and program inputs, even if the findings are sometimes challenging to understand. This research also aims to provide findings as recommendations regarding the use of drones in Myanmar's conflict.

3.2 Data Collection and Analysis at the Preparatory Phase

The preparatory phase of this research establishes a foundational understanding of the context and dynamics surrounding drone usage in Myanmar's armed conflict. It systematically reviews existing literature and collects and analyses open-source data, primarily from social media platforms.

3.2.1 Systematic Review

A systematic review serves as the foundation for developing the research question. As Newman and Gough (2020) suggest, a systematic review aids secondary research in answering a research question by consolidating primary research findings. Compared to traditional literature reviews, employing a systematic review helps extract information on the research design of primary literature, particularly the sampling method in this research (Mallett et al., 2012).

A systematic review of relevant literature on conceptualising war/civil war and non-state actors' adoption of drones in asymmetrical warfare is the foundation for this research. This approach ensures a comprehensive and unbiased understanding of the existing knowledge base, identifying research gaps and formulating focused research questions. The systematic review also aids in extracting information on the research design of primary literature, particularly the sampling methods employed in previous studies.

3.2.2 Open-Source Data Collection

The preparatory phase also includes collecting open-source data from social media platforms and local media reports. This approach allows for the collection of a vast amount of real-time data, providing valuable insights into the public discourse and narratives

surrounding drone usage in Myanmar's conflict. The focus on local media reporting and Facebook is particularly relevant in Myanmar, where Facebook is a primary source of news and information dissemination, even amidst restrictions imposed by the military regime. The utilisation of these platforms by anti-junta resistance groups further underscores their significance in understanding the dynamics of drone adoption and usage in the conflict.

Keywords in English and Burmese are used to identify relevant social media posts, articles, and videos related to drone units, projects, fundraising campaigns, and operations. The collected data is then analysed using content and discourse analysis to identify patterns, themes, and narratives related to drone adoption and its impact on the conflict. The insights gained from this analysis contribute to a broader understanding of the public perceptions and discourses surrounding drone usage in Myanmar, complementing the findings from the interviews and other data sources.

3.3 Case Development

The case development phase involves identifying and selecting specific cases that exemplify the research questions and hypotheses. The study focuses on the drone wings of three prominent anti-junta resistance groups in Myanmar, strategically chosen to represent a diverse range of operational contexts and organisational structures.

The first case study centres on a drone unit located in central Myanmar, a region predominantly inhabited by the Bamar ethnic majority. This unit is unique in its direct subordination to the newly formed exiled government established after the coup, highlighting the evolving political landscape and its impact on resistance group formations. The second case study examines a drone unit operating in eastern Myanmar, specifically within the Karenni state. Despite being the least developed in Myanmar, this state holds strategic geographical significance due to its proximity to the regime's capital, Naypyidaw, and has garnered substantial international attention. While not entirely new, the drone unit in this region represents a relatively recent addition to the resistance movement, operating with support from the diaspora community. The third case study investigates a drone unit situated in southern Myanmar, within the Karen state, an area with a long history of ethnic armed conflict dating back to the country's independence. This unit operates under the command of one of the oldest ethnic armed organisations in Myanmar, providing a

contrasting perspective on drone adoption within a more established resistance structure.

The selection of these three cases is based on several key factors:

- **Active use of drones in combat operations:** All three groups have demonstrated a consistent and active utilisation of drones in their military operations, making them ideal candidates for examining the impact of drone technology on conflict dynamics.

- **Diverse geographical locations:** The geographical spread of these groups across central, eastern, and southern Myanmar allows for an exploration of how regional contexts and variations in terrain influence drone adoption and usage strategies.

- **Varying levels of organisational complexity:** The groups exhibit different levels, ranging from the newly formed unit under the exiled government to the more established unit within the older ethnic armed organisation. This diversity enables an examination of how organisational structures and histories influence the integration and utilisation of drone technology.

- **Distinct command structures:** The groups also differ in their command structures, with the central unit being directly under the exiled government, the eastern unit operating with diaspora support, and the southern unit under the command of an established ethnic armed organisation. This variation allows for analysing how different leadership and command structures impact decision-making processes and strategic approaches to drone usage.

By examining these three distinct cases, the study aims to provide a nuanced and comprehensive understanding of how drone technology shapes resistance groups' tactics, strategies, and social organisation in Myanmar's complex and evolving conflict landscape.

3.4 Data Collection for the Cases

Data collection for the case studies involves a combination of primary and secondary sources.

3.4.1 Social Media Analysis

Social media analysis provides a broader perspective on the public discourse and narratives surrounding drone wings and their activities. The data collected in the preparatory phase served as a foundation for further refining the case selection process. The initial focus was on three pages with drone production and massive fundraising programs. However, recognising the complexity of armed group networks, campaigns, and engagement areas, a deeper examination of specific campaigns was undertaken.

The analysis involved examining Facebook updates about fundraising, production, and military operations, utilising keywords to identify relevant posts. The discovery of unique hashtags associated with each event facilitated a more targeted and efficient data collection process. The focus remained on the post content and hashtags, excluding comments from the analysis.

A manual data collection tool on an Excel sheet was employed to categorise the data into three distinct stages:

1. **Collecting Facebook pages representing drone units:** This initial stage involved compiling a list of Facebook pages associated with drone units, building upon the data gathered in the preparatory phase.

2. **Identifying units with production capabilities:** From the compiled list, pages representing units engaged in drone production were identified and selected for further analysis.

3. **Examining posts about product testing, battlefield deployment, and campaigns:** The final stage involved examining closely posts related to product testing, battlefield deployment, and specific campaigns, with a particular focus on the unique hashtags associated with each event.

This systematic approach to social media analysis allowed for a more focused and in-depth exploration of the selected drone units and their activities, providing valuable insights into their operational strategies, technological advancements, and public engagement efforts. The combination of social media analysis and interviews with key actors offers a comprehensive understanding of the drone wings' roles and impact within the

broader context of Myanmar's armed conflict.

3.4.2 Interviews with Key Actors

Semi-structured interviews with key informants involved in drone operations within the selected resistance groups are conducted. These interviews provide firsthand accounts of the experiences, challenges, and motivations of individuals directly involved in drone adoption and usage. The interviews also offer insights into drone wing decision-making processes, organisational structures, and technological adaptations.

3.4.3 Types of Respondents

The following table provides an overview of the types of respondents interviewed for this study:

No.	Category	Types of Respondents	Number of Respondents	Method of Sampling
1	Analysts/ Observers	Analysts and Researchers from regional security think tanks.	4	Purposive Sampling
2	Journalists	Those who were in the frontline in the early days of armed resistance but now in safe places, outside of Myanmar and Thailand	2	Purposive + Snowball Sampling
		Those who worked for international media agencies but continuously covering Myanmar issues	1	Snowball Sampling
3	Anti-junta Activists	Those from ethnic diaspora communities	4	Snowball Sampling
		Those from overseas fundraising teams but not with an ethnic background	4	Snowball Sampling
TOTAL NUMBER OF PARTICIPANTS			15	

Table 3:1 Types of Research Participants and Method of Sampling

3.4.4 Interview Strategy

The semi-structured interviews allowed for flexibility and adaptability while ensuring that key themes and topics were covered. The conceptual framework and the following research questions guided the structure of the interviews:

- What are the motivations and decision-making processes behind the adoption and use of drones by resistance groups in Myanmar?
- How has the use of drones impacted the tactics, strategies, and social organisation of these groups?
- What are the implications of drone usage for the broader conflict dynamics in Myanmar?

The interviews consisted of three main sections:

1. **Participants' first observation on the use of drones in the Myanmar conflict:** This section aimed to gather initial impressions and observations about the emergence and impact of drones in the conflict, providing context for the subsequent discussions.
2. **The dynamics of using drones on the battlefield:** This section explored the practical aspects of drone usage, including the evolution of tactics and strategies, technical and organisational challenges, and the role of fundraising and resource mobilisation.
3. **Implications and possible scenarios:** The final section focused on the broader impact of drone usage on the conflict dynamics in Myanmar, including potential future developments and scenarios. The open-ended nature of this section encouraged participants to share their insights and perspectives on the evolving role of drones in the conflict.

The semi-structured format of the interviews balanced structure and flexibility, ensuring that critical topics were addressed while also allowing for the exploration of emergent themes and unexpected insights. The interviews were conducted conversationally and respectfully, creating a safe space for participants to share their experiences and perspectives openly and honestly.

3.5 Data Analysis and Interpretations

The data analysis process involves several stages, beginning with the transcription and translation of interview data, followed by thematic and discourse analysis. Process tracing is then employed as the primary analytical framework to examine the causal mechanisms and processes underlying drone adoption and its impact on conflict dynamics (Lyall, 2014).

3.5.1 Data Analysis and Interpretations

Process tracing is a qualitative research method that focuses on identifying and analysing the causal mechanisms and processes that link a cause to its effect. It involves carefully examining the events and interactions that lead to a particular outcome, allowing researchers to develop causal-process observations (CPOs) and generate causal inferences (Lyall, 2014, p. 191). In this research, process tracing is employed to understand the complex and dynamic processes involved in drone adoption and usage by anti-regime resistance forces in Myanmar.

The process tracing analysis involves the following steps (Lyall, 2014, p. 205):

1. **Identifying key events and actors:** This involves identifying the critical events and actors involved in the selected resistance groups' adoption and use of drones.

2. **Developing causal-process observations (CPOs):** This involves creating a set of CPOs that describe the sequence of events and interactions that led to the observed outcomes.

3. **Generating causal inferences:** This involves using the CPOs to generate causal inferences about the relationship between drone adoption and its impact on conflict dynamics.

3.5.2 Rationale for Process Tracing in Security Studies Research

Process tracing is considered an invaluable tool in civil war research, as it enables scholars to uncover the intricate processes that contribute to conflict onset and dynamics (Lyall, 2014). In security studies, it has become a core method for case explanation and

general theory analysis (Mahoney, 2015). The method is particularly well-suited for investigating rare events that lack easily quantifiable data, making case study approaches and process tracing methods highly relevant (Tannenwald, 2015). Process tracing's strength lies in its ability to address complicated multicausality, making it a valuable tool for understanding complex security phenomena (Tannenwald, 2015). The origins of security studies in diplomatic history, emphasising decision-making and leadership studies, have also contributed to developing and applying process tracing methods to elucidate causal mechanisms behind specific policy decisions (Tannenwald, 2015).

3.5.3 Why Process Tracing is Chosen for Research on Civil War/Armed Conflict Dynamics in Myanmar

In the context of civil war/armed conflict dynamics in Myanmar, process tracing is valuable for several reasons (Lyall, 2014):

1. **Deep Understanding of Complex Factors:** It allows for a deep understanding of the complex and multi-layered factors contributing to conflict by tracing the processes and mechanisms that lead to conflict escalation (Mahoney, 2015). Researchers can identify key turning points, decision-making processes, and interactions between actors and structures. This is crucial for developing effective policies and interventions to address the root causes of conflict and promote peacebuilding.

2. **Uncovering Hidden Dynamics and Motivations:** Process tracing can help find the hidden dynamics and motivations of actors involved in the conflict (Mahoney, 2015). In Myanmar, where the conflict is characterised by a complex interplay of ethnic, political, and economic factors, process tracing can shed light on the underlying grievances, interests, and strategies of different groups. This information is essential for understanding the conflict's intractability and identifying potential avenues for dialogue and reconciliation.

3. **It is developing Nuanced and Context-Specific Conflict Theories:** Process tracing can create more context-specific conflict theories (Mahoney, 2015). By examining the specificities of the Myanmar case, researchers can refine existing theories and develop new frameworks that better capture the complexities of

armed conflict in the country. This can lead to more accurate predictions and more effective policy recommendations.

Furthermore, process tracing is instrumental in understanding the events leading up to war (Lyall, 2014). By examining the timing and nature of events, researchers can gain insights into the causal pathways and interactions that contribute to conflict escalation. Process tracing can also help disentangle the indirect effects of various factors, such as state capacity, on the mechanisms proposed by different theoretical arguments (Lyall, 2014). For instance, in the case of Myanmar, process tracing could be used to examine the specific events and decisions that led to the escalation of armed conflict and the role of various actors and institutions in shaping the conflict's trajectory.

The following expresses the causal chain linking the Myanmar Armed Forces' massive airstrikes to the resistance groups' strategic shift of seeking advanced weapon systems and air defence capabilities.

Causation	Outcome	Political Process	Strategic Practice
Massive Airstrikes by Myanmar Armed Forces	The resistance forces' seeking for air defense or more advanced weapons to fight against the military regime	Increased advocacy efforts for military aid and support	Shift towards conventionalized warfare, aiming to establish air defense and potentially challenge regime's air superiority
Adoption of commercial drones by resistance groups	Increased tactical capabilities and operational flexibility	Enhanced ability to challenge the military regime's control and conduct effective combat operations	Development of new tactics and strategies, such as targeted strikes and asymmetric warfare
Transition to in-house drone production	Reduced reliance on external suppliers and increased self-sufficiency	Greater autonomy and resilience for resistance groups	Development of indigenous technological capabilities and reduced vulnerability to supply chain disruptions

Emergence of complex networks for drone development and deployment	Enhanced coordination and collaboration among resistance groups and their supporters	Strengthening of the resistance movement and potential for increased international support	Formation of new strategic alliances and information-sharing networks

Table 3:2 Process Tracing Analysis of Resistance Groups' Drone Adaptation

3.6 Limitations of the Study

While this research employs a comprehensive methodological approach, it is essential to acknowledge its limitations. The small-scale nature of the study and the reliance on a limited number of interviews may limit the generalizability of the findings. Additionally, the ongoing conflict and the politically sensitive nature of the research topic can challenge data collection and analysis.

In addition, reliance on Facebook data for social media analysis presents further limitations. The platform's algorithms and content moderation policies can influence the visibility and accessibility of certain types of information, potentially introducing biases into the data collection process. The dynamic nature of social media content, with posts and comments frequently deleted or modified, can also affect the reliability and reproducibility of the analysis. Furthermore, focusing on Facebook data may exclude valuable insights from other social media platforms or online forums actively used by resistance groups and other stakeholders in the conflict.

Furthermore, using process tracing as the primary analytical framework while offering valuable insights into causal mechanisms also has limitations. It can be time-consuming and resource-intensive, and relying on qualitative data can make it challenging to establish definitive causal relationships.

3.7 Ethical Considerations of Research in Myanmar

Conducting research in conflict settings like Myanmar necessitates a heightened awareness of ethical considerations, particularly concerning participant safety and confidentiality. Given the politically sensitive nature of the research topic and the potential

risks associated with interviews, although it was conducted online remotely, this study prioritises the security and anonymity of its participants.

Alternative data collection methods of remote interviews mitigate risks by allowing participants to choose the mode of communication they feel most comfortable with. The use of pseudonyms and the anonymisation of data further protect participant confidentiality. The research team adheres to strict ethical guidelines, obtaining informed consent from all participants and ensuring that the research findings are not used in ways that could exacerbate the conflict or put individuals at risk.

All interviews are conducted in the participant's native language, with the researcher taking sole responsibility for accurate translation and interpretation. No participants under 18 are involved in the study, and extra precautions are taken to ensure participant privacy and data protection, including refraining from uploading or utilising collected data on any social media platform.

4 Empirical Finding 1: How Armed Resistance Forces in Myanmar Use Drones

The conflict in Myanmar has a long and complicated history, stretching back to the country's independence from British colonial rule in 1948. Since then, Myanmar has been afflicted by insurgency and civil war, with various ethnic armed organisations , the Karen National Liberation Army (KNLA) and Kachin armed groups, and ideologically driven organisations such as the Burma Communist Party (Callahan, 2005; Myoe, 2009). Those organisations continuously engaged with the Myanmar Armed Forces (MAF) (Tatmadaw) in protracted conflict. In the early days of the country's independence, right after the end of World War II, the availability of firearms was beyond control. Therefore, these conflicts have traditionally been characterised by conventional firearms.

Between 1948 and 1952, post-independent government could not gain any control across the nation. With the rise of armed struggles, the power dynamic and influence of the Myanmar Armed Forces widened and made its foothold into the realm of politics (Callahan, 2005; Myoe, 2009). MAF officially seized power in 1962 with the first military coup, and since then, the nature of conflict in the country has evolved. Historically, MAF has relied on the traditional defence industry for small arms and light weapons (SALW) and the official arms trade with other countries (Myoe, 2009). At the same time, ethnic armed organisations often sourced their weaponry from the black market. However, groups like the United Wa State Army (UWSA) and Myanmar National Democratic Alliance Army (MNDAA), whose controlled area is next to the border with China, have had their defence facilities (BBC Burmese, 2010, 2013). However, all those defence facilities owned by the state or non-state organisations produce conventional small arms and light weapons. In addition, this traditional approach to warfare persisted until the late 2010s.

However, the conflict landscape in Myanmar began to change significantly after the military coup in 2021. The decade of democratisation from 2010 to 2020 exposed the youth and the broader population to advancements in technology and communication (Thant, 2021). This exposure has played a crucial role in the resistance movements post-coup, leading to the increased and more sophisticated use of technology, including commercial drones and fundraising methods.

The use of drones in Myanmar is not a new phenomenon; reports said MAF had been using them as early as 2015, primarily for reconnaissance and surveillance. The type of drones used by MAF was imported from China – CH-3A UAVs, and some of them were

displayed during the Armed Forces Day Parade in 2015 (tarpitz, 2015). Some report the deployment of drones for operations against ethnic armed groups. According to data and reports, the Myanmar army had air superiority (Parameswaran, 2019). Therefore, observers have speculated about the EAO's acquisition of man-portable air defence systems (MANPAD) to tackle the MAF's assault from the air.

Before 2021, massive airstrikes were in the hilly regions; however, after the coup, airstrikes were frequently conducted in plain regions (Panda, 2016; Parameswaran, 2019). Therefore, newly formed groups are no exception to the regime's airstrikes. As of late 2022, observers have speculated on the need for air defence systems and missiles to retaliate against the air strike (Davis, 2023). As of early 2023, national researchers have raised the emerging issue of using drones by resistance forces and highlighted how competent the tactic of drone adoption was (Oo and Sin, 2023; Sin, 2023, 2024). Then, a highlighted interest in the use of drones has become a noticeable shift. Drones are now being used more extensively in combat, offering new strategic advantages and becoming increasingly massively deployed.

A dynamic interplay of traditional and modern warfare tactics has characterised the ongoing conflict in Myanmar. The use of drones, or Unmanned Aerial Vehicles (UAVs), has emerged as a particularly significant development, reshaping the battlefield and influencing the strategies of both state and non-state actors (*In Pictures: How Myanmar's resistance fights with drones*, 2023; Myint, 2024). While the presence of drones in Myanmar's conflicts is not entirely new, the 2021 military coup has catalysed a dramatic shift in their utilisation and impact. This chapter explores the evolution of drone warfare in Myanmar, tracing its trajectory from early adoption for reconnaissance and surveillance to its current role as a potent and often destructive tool in the ongoing conflict. The central argument is that the coup d'état served as a turning point, accelerating the adoption and adaptation of drone technology for combat purposes, with far-reaching implications for the dynamics of the conflict.

4.1 Armed Conflict and Weapon System in Myanmar

The weapons systems in Myanmar's armed conflicts have traditionally been very conventional, primarily relying on small arms and light weapons. This has been the case

since the early days of independence and the onset of the civil war in 1948. Although Myanmar's weapon systems are largely conventional, the military maintains a significant advantage, particularly in terms of air superiority. They have utilised airstrikes since 1948, leveraging resources inherited from the British colonial defence system and World War II. Consequently, while Myanmar's air conflict remains conventional, it is characterised by its asymmetrical nature.

Adding to the asymmetrical warfare, it is necessary to note that the chiefs of the Myanmar military have consistently sought to upgrade and modernise the armed forces over time. The latest commander-in-chief, Min Aung Hlaing, frequently emphasised military modernisation between 2010 and 2020 (Lim and Wu, 2017; Parameswaran, 2019). This period saw significant purchases and investments in defence, making defence expenditure the highest in the country's history (*Myanmar Military Spending/Defense Budget 1960-2024*, 2023). This push for modernisation was a prominent and well-publicized initiative within Myanmar. Therefore, it can be assumed that the acquisition of drones occurred during his tenure as commander-in-chief and was managed by the Myanmar military.

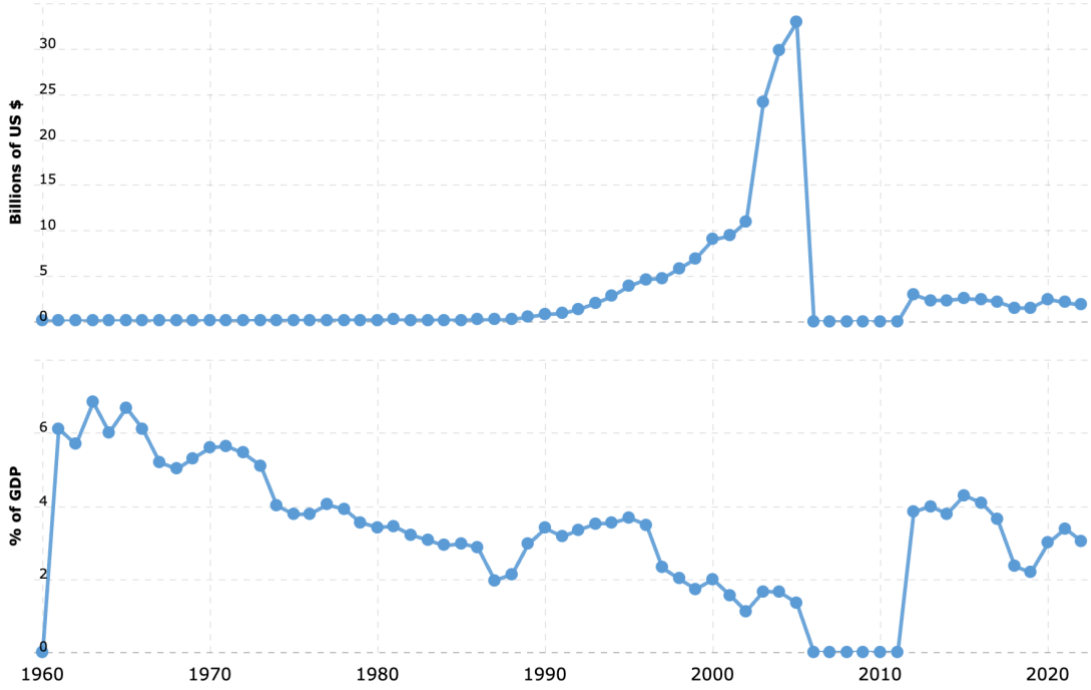

Figure 4-1 Myanmar Defence Expenditure (Macrotrends, 2023)

4.2 Early Drone Adoption in Myanmar

The use of drones in Myanmar is not a new phenomenon. The Myanmar military has been utilising drones as early as 2013, particularly in the northeastern and northern conflict areas (tarpitz, 2015; Panda, 2016). In 2015, the Myanmar military showcased its drones during the Myanmar Armed Forces Day parade, signalling their increasing importance in the military's arsenal and strategy (Gettinger, 2020)[2]. In addition to the reconnaissance drone, the Myanmar military deployed the Unmanned Aerial Vehicle to harass the Arakan Army in the Rakhine State back in 2019 (Chan, 2020). Despite this, the use of drones by the Myanmar military has been largely under-reported in discussions about security and counter-insurgency operations in the region. This represents a significant gap in the literature, as the deployment of such technology in Myanmar's armed conflicts, and indeed in Southeast Asia more broadly, is not well documented. Analysts who are observing the conflict in Myanmar and the use of weaponry provided this information during research interviews.

Furthermore, the use of drones is not limited to the Myanmar Armed Forces. Ethnic armed organisations such as the United Wa State Army (UWSA), the Myanmar National Democratic Alliance Army (MNDAA), and the Kachin Independence Army (KIA) have also been using drones for reconnaissance purposes between 2013 and 2019[3]. However, this aspect of drone use is also rarely discussed in the context of Myanmar's armed conflict. These three organisations are located near the Chinese border and maintain strong relations with China, which has likely facilitated their access to drone technology.

One of my research participants, an analyst and expert on the use of weapon systems in Myanmar conflicts, mentioned that these three organisations also possess their own armed protection facilities in their areas. While the participant did not suggest direct support from the Chinese government, either the Provincial Government of Yunan or Beijing, he did note that it is unclear who exactly is providing the technical assistance to these groups and it is evident that they are receiving foreign technical assistance for their drone operations.

[2] The Drone Data Book 2020.
[3] Interview Data

4.3 Conflict context after the coup

When the coup occurred in February 2021, the population responded with widespread protests and non-violent movements. These included the Civil Disobedience Movement (CDM), which aimed to disrupt the bureaucratic mechanisms of the military regime through mass non-cooperation and strikes (HRW, 2021). Additionally, there was a widespread boycott of military-owned enterprises. Despite these non-violent efforts, the military responded with massive violence and severe human rights violations, including extrajudicial killings and excessive criminalisation and politicisation. As a result, many protesters, particularly the youth, fled to areas controlled by ethnic groups to receive basic military training (Thant, 2021).

After completing basic training, many youths returned to urban areas to conduct underground operations, while others returned to their rural hometowns to join the armed resistance movement. This shift began three months after the coup. On April 16, 2021, exiled parliamentarians and ruling party members, the National League for Democracy (NLD), formed the National Unity Government of Myanmar (NUG), a parallel government entity (Myers, 2021). The NUG subsequently established the Ministry of Défense (MOD) and officially announced the formation of the People's Défense Forces (PDF) on May 5, 2021, marking the beginning of the armed resistance movement (Hein, 2022b).

On September 7, 2021, the NUG declared a People's Defensive War, calling for public participation in the fight against the military junta across the country (Hein, 2022b). The conflict was characterised by asymmetrical warfare during the initial phase from May to December 2021. The opposition forces, including the NUG, faced significant challenges due to a shortage of arms and funding. This led to a strategy focused on hit-and-run tactics rather than full-scale warfare.

With the onset of the armed resistance movement, numerous armed groups emerged nationwide. In EAO-controlled areas, the conflict remained conventional, involving small arms and light weapons (RFA Burmese, 2023). However, there was a significant shortage of weapons in newly formed resistance areas within the Burma-dominated plains. As a result, resistance fighters relied heavily on improvised explosive devices (IEDs) and landmines. Throughout 2021, landmines proved to be an effective tactic against the military.

Even with the conflict's asymmetrical nature, the Myanmar military utilised its air force to strike against the newly formed resistance groups. The People's Défense Forces (PDF) operated within areas controlled by ethnic armed organisations (EAOs), leading the military to wage war not only against the PDF but also against these EAOs (Myers, 2021). Massive airstrikes were employed, particularly in EAO-controlled areas. Additionally, airstrikes extended to Burma-dominated regions, which had not seen conflict in the past sixty years. Despite this, the military's use of airstrikes, including bombings from fighter jets and helicopter gunfire, inflicted significant damage on local populations.

4.4 Renaissance of Resistance's Air Power

With the massive escalation of conflict across the country, there has been a significant increase in armed resistance forces. According to an article by author Aye Chan Su, published in the Burmese edition of The Irrawaddy, as of 2023, at least 291 PDF battalions are operating in various states and regions of Myanmar. These battalions are estimated to comprise approximately 58,200 service personnel, with an average of 200 members in each battalion (အေးချမ်းဆု, 2023). The PDF estimates that nearly 75,000 members actively participate in armed resistance activities. These forces are active in regions including Ayeyarwady, Bago East, Bago West, Kayah (Karenni), Karen, Magway, Mandalay, Mon, Naypyidaw, Sagaing, Shan North, Shan South, Tanintharyi, and Yangon (အေးချမ်းဆု, 2023).

A significant portion of the manpower of these resistance groups consists of technologically expert youths. According to my research participants, including journalists, analysts, and anti-coup activists, many of these service personnel are young and technophile individuals. This group includes gamers experienced in playing video games, particularly shooting games like PUBG and Mobile Legends. They began to consider the potential use of drones for their operations. Initially, this idea was met with scepticism and humour, but by late 2021, they started experimenting with and deploying drones.

4.5 Empirical Findings

During my preparatory data collection stage, I explored the use of drones by

employing specific keywords on Facebook. I used terms such as “drones” and “wings” in both Burmese and English, as well as words related to the sky. This search yielded 129 pages that represent drone units across the nation. Of the 129 supposed drone units across the country, the highest number of drone units or units with Facebook pages are in the Sagaing region. Following closely, there are 14 groups in the Karen region, which shares a border with Thailand.

State and Region with Active Drone Unit	Number of Facebook Pages Available
Bago	3
Magway	13
Mandalay	13
Sagaing	69
Tanintharyi	5
Kayah	4
Kayin	14
Mon	3
Shan (South)	4

Table 4:1 Number of Drone Unit with Facebook Pages

I have also included a map of these findings to illustrate the geographic distribution of the drone units.

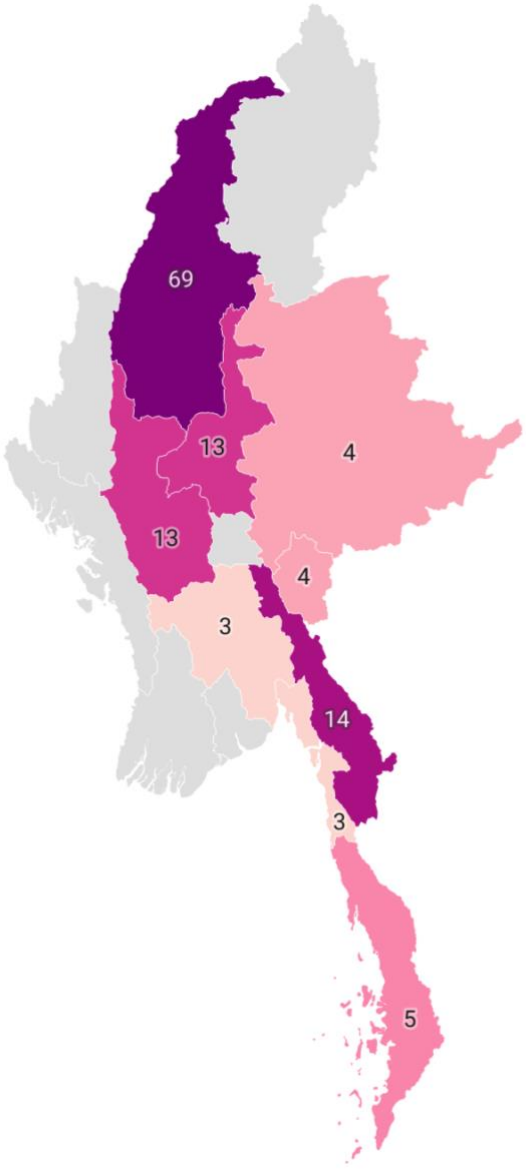

Figure 4-2 Number of Drone Units with Facebook Pages by State and Regions

Additionally, I examined the creation times of these Facebook pages. This analysis provided further context on when these drone units began to organise and publicly document their activities, offering a timeline of the proliferation of drone technology among resistance groups.

I looked at the timeline of the creation of these Facebook pages from January 2021 to June 2024 in six-month intervals. Although the military coup happened in February 2021 and the armed resistance officially started in May 2021, it was observed that from January to June 2022, the number of drone units or units with Facebook pages representing them

rose to 24. The numbers continued to rise, averaging between 20 and 21 units in each six-month interval from July 2022 to June 2023. From July 2023 to December 2023, the number of drone units reached its highest level, indicating a significant increase in the organisation and deployment of drone technology over the span of a year.

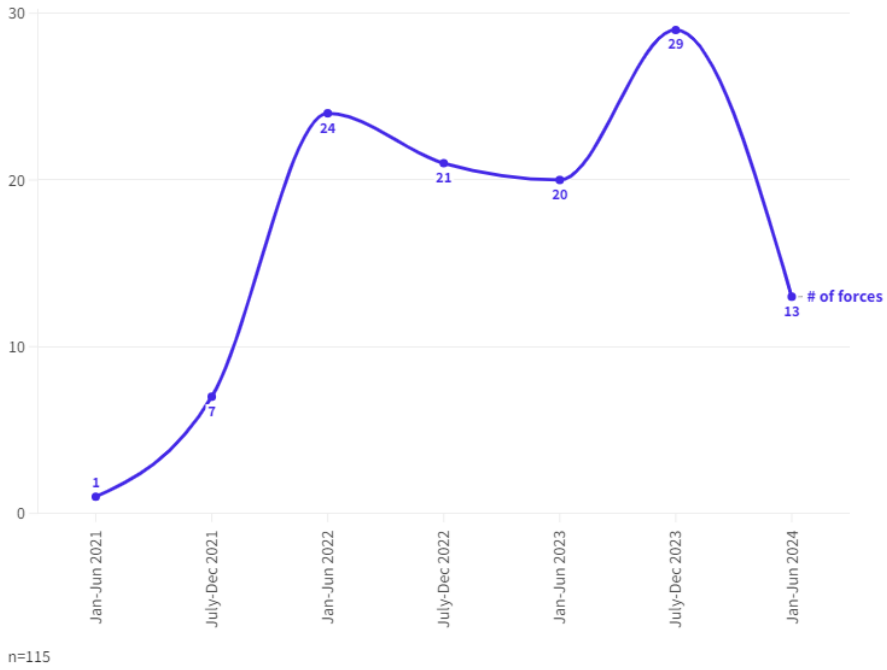

Figure 4-3 Number of Drone Units' Facebook Pages over the Year between January 2021 to June 2024

4.6 Types of Drone Use by Resistance Forces

In this section, I will focus on the various types of drones employed by the resistance forces, particularly the People's Défense Forces (PDF). Through my research, I have identified several key categories and models of drones that have become prevalent in their operations. The most commonly used drones are commercial off-the-shelf models, such as DJI. These drones are favoured for their affordability, ease of use, and availability. They are primarily used for reconnaissance missions, providing real-time aerial surveillance to gather intelligence on enemy movements and positions.

Resistance forces have also started using modified drones in addition to commercial drones. These modifications often involve adding improvised explosive devices (IEDs) or other forms of payloads to carry out targeted attacks. Such drones allow the resistance to

strike military targets with precision and then quickly retreat. Another notable type of drone in use is the fixed-wing drone. These drones offer longer flight times and greater range, making them suitable for extended surveillance missions and covering larger areas.

Lastly, there have been instances of the resistance forces using locally assembled drones. These drones are often built using parts sourced from various suppliers and assembled with the help of local technicians and engineers. While these homemade drones may lack the sophistication of commercial models, they reflect the ingenuity and resourcefulness of the resistance forces in adapting available technology to their needs.

4.7 Factors behind the Drone Use

In this section, I will discuss the patterns of drone use by resistance forces and the factors motivating their adoption of drone technology. The information presented here is based on findings from my research interviews.

Motivation: The primary motivation behind the adoption of drone technology by resistance forces was the need to level the playing field against the military's superior firepower and air superiority. Another significant motivation was the inspiration drawn from the successful use of drones by Ukrainian resistance forces. According to one anti-Junta activist, resistance groups in Myanmar have been learning to assemble and produce drones by watching YouTube videos and accessing websites shared by Ukrainian forces. Ukrainian designs directly inspire some drone models used by the resistance. Quoting my interviewees:

> An analyst on regional security issues stated, ***"Drones were kind of seen as a way to equalise the playing field, especially given the military's air superiority."***

> A researcher on regional conflicts, including the war in Vietnam and insurgencies in Asia, mentioned, ***"The youth groups that put together the origin and drone units were very much inspired by what they saw the Ukrainians do."***

One notable case of inspiration from Ukrainian drone technology is the KNDF UAV Department, which has gained recognition for its drone production and deployment on the frontline. This unit produces drones using 3D printers and fibreglass, taking inspiration from the Ukrainian-made Punisher drone. They named their version the Liberator Version 2.

Although it is a small, fixed-wing reusable drone, it can carry up to 1.5 kilograms of explosives.

Technology: The availability of relatively cheap commercial drone technology and readily available munitions, particularly improvised explosive devices (IEDs), has been crucial in effectively adopting and utilising drones by resistance forces. The technological adeptness of the youth, including engineering, science, and technology students, has also contributed significantly to the rapid adoption and adaptation of drone technology. As one research participant noted, "***It's still not cheap, but relatively cheap commercial drone technology"*** has enabled resistance groups to integrate drones into their operations effectively. An observer of the regional crisis commented, ***"These are young and smart, technologically, in many cases, technologically savvy... They understand technology."***

Organisational Resistance: The literature reviewed for this research suggests that organisations often resist adopting new technologies due to the costs involved, particularly in financial and human resources, as well as a general reluctance to change established practices. **I assumed that resistance could be observed for two reasons – first, old armed groups like EAOs would be resisting the adoption of drones because they had been using traditional firearms. Second, the newly formed NUG would not be in favour because leadership in NUG MOD were with civilian backgrounds and the organisation itself has financial limitations.** However, my research interviews revealed a different scenario for the resistance groups in Myanmar. **All four analysts I interviewed stated that they did not observe any significant organisational resistance to adopting drone technology, regardless of the group's location and chain of command. <u>This lack of resistance is attributed to the fact that these groups are not well-established or institutionalised organisations, making them more flexible and open to innovation.</u>**

Other respondents noted that while there was some initial hesitation in using drones, this reluctance was quickly overcome. As gathered from my other respondents, including anti-junta activists and journalists, the primary reason for hesitancy and reluctance was financial. The leaders of ethnic armed organisations (EAOs) perceived drones as more expensive than traditional guns and other munitions. This financial concern was significant because a failure in the aviation software would result in a substantial financial loss. To overcome this reluctance, those involved in drone units had to undergo extensive testing and

validation processes. They had to prove the effectiveness of drones in actual battlefield conditions. Only after these tests proved successful did the senior leadership begin to recognise the value of drones. Consequently, drones are now widely deployed across various resistance groups. These research participants uniformly said, ***'Now, drones have become our essential must-have-list before going to the frontline."***

4.8 Patterns of Drone Use

From late 2021 to today, the deployment and utilisation of drones in Myanmar have evolved significantly. In the early days of drone usage, resistance forces primarily purchased drones from other countries. They acquired these drones through online platforms such as Amazon and shipped them across the border into Myanmar.

By 2022 and 2023, there was a noticeable shift towards local production. Due to the high costs of spare parts and the overall expense of drones, resistance groups began using 3D printers to produce and modify drone components. This shift reduced costs and allowed for greater customisation and adaptation of drones for specific needs.

In addition to homemade drones, resistance groups started purchasing larger agricultural drones, which were then modified to carry loitering munitions (LOM) or similar explosive payloads. These larger drones enabled more substantial and impactful operations against military targets.

Despite these advancements in local production and modification, resistance forces still rely on purchasing specialised components and drones from external sources. This blend of locally produced and externally sourced technology highlights the adaptability of the resistance groups in Myanmar.

4.9 Process Tracing of Drone Use

I employed the process tracing method to analyse the use of drones in Myanmar systematically. The following table outlines the key aspects of drone usage over time, categorised by use, actor, purpose, drone type, and significance. The table below provides a clear overview of how drone technology has evolved in Myanmar, highlighting the key actors, purposes, types of drones used, and the significance of these developments.

Period	Actor	Purpose	Drone Type	Significance
2013-2015	AF	Reconnaissance	Commercial, modified	Initial adoption for intelligence gathering, limited impact
2016-2020	AF	Surveillance, limited strikes	Military-grade	Increased sophistication
2021	DF	Reconnaissance, propaganda	Commercial	Early adoption by resistance, leveraging affordable technology
2022-2023	DF	Reconnaissance, offensive strikes	Modified commercial	Significant impact in leveling the battlefield, inspired by Ukraine

Table 4:2 Process Tracing of Drone Use

4.10 Conclusion

This chapter has explored the evolving use of drone technology by resistance forces in Myanmar, particularly following the military coup in 2021. Initially, the Myanmar military and other big EAOs' adoption of drones was relatively under-reported, but their use has significantly expanded and evolved over time. The resistance forces, especially the People's Defense Forces (PDF), have adopted drones to level the playing field against the military's superior firepower and air superiority. Inspired by the successful use of drones by Ukrainian resistance forces, Myanmar's resistance groups have leveraged relatively affordable commercial drone technology and improvised munitions to create effective loitering munitions.

The chapter examined the patterns of drone use, noting the flexibility and innovation shown by these groups despite initial financial hesitancy. The integration of technologically adept youth and the influence of Ukrainian designs, such as the KNDF UAV Department's Liberator Version-2, underscore the adaptive strategies employed by the resistance.

Drones have altered the battlefield by providing the resistance with enhanced reconnaissance capabilities and the ability to conduct precise strikes. This has led to increased effectiveness in their operations and has created a psychological impact on the

Myanmar military, who now face a more formidable and unpredictable adversary. Although there has been a significant evolution in drone usage in Myanmar, numerous challenges persist. These include technological limitations and funding constraints, among others. A detailed examination of these challenges will be provided in the following chapter.

5 Empirical Finding 2: Challenges and Differences in Drone Adoption

As stated in the previous chapter, the journey of adopting and using drones was not smooth for the resistance forces in Myanmar. The youth had to prove the capability and viability of drone technology to the older generation of armed forces members. When the youth of the drone unit gained momentum in using and deploying drones on the battlefield, they still faced significant challenges in the long run, particularly regarding technological limitations and resource constraints.

Despite their enthusiasm and initial success, the resistance forces faced technological limitations. Although they accessed information through YouTube and other internet sources, it was often their first time adopting such advanced technology. This led to challenges in understanding and implementing drone technology, as most of the training materials and resources were in English, creating a language barrier they had to overcome. In addition to these learning curve issues, they encountered several resource constraints, including financial, logistical, human resources, and infrastructure limitations. These constraints varied across the nation, heavily influenced by geographic location.

Initially, I planned to explore the stories of three different L3 drone units in the Karen, Karenni, and Sagaing regions, focusing on their unique approaches to drone production and fundraising methods. However, due to the ongoing conflict in the country, I could not reach out to the activists supporting these units directly, as they were occupied with ad hoc operations and other urgent matters. Instead, I connected with activists and fundraisers in the diaspora community who are supporting drone units in three different regions: the southern, eastern, and central/western command regions. Consequently, this chapter analyses the challenges and dynamics based on these regions rather than focusing on specific groups.

These regions were selected due to their unique geographical and ethnic characteristics, which influence their challenges in drone adoption. The southern region, which borders Thailand, is predominantly ethnic. Due to its proximity to the border and the ethnic composition of its population, this region faces specific logistical and infrastructural challenges. The terrain and cross-border dynamics play a significant role in the operational capabilities of drone units here. The eastern region shares borders with China and Thailand and is another prominent ethnic area. This region also encounters unique challenges influenced by its border location and ethnic diversity. The cross-border interactions and the terrain complexity affect the logistical support and infrastructure available for drone

operations. The central/western region, while geographically supposed to be close to India, actually experiences significant challenges due to difficult terrain and other geographic factors. This region is predominantly a plain area with a majority Burma-dominated population. The operational environment here differs from the ethnic border regions, impacting drone units' logistical and infrastructural constraints.

In addition to geographic and ethnic differences, the command structure of resistance forces also varies across these regions. For example, in the Karen State, resistance forces such as the PDF often conduct joint operations with the Karen National Liberation Army (KNLA), resulting in a joint command structure involving both the KNLA and the NUG Ministry of Defense. In the Karenni State, I examined the Karenni Nationalities Defense Force (KNDF). Although the KNDF is a newly formed and coordinated force, it operates under the sole command of the Karenni ethnic group rather than the NUG chain of command. In contrast, the resistance forces in the central regions operate purely under the command of the NUG. This centralised command structure reflects the Burma-dominated population in these plain areas and their closer alignment with the NUG's strategic objectives.

By examining these three regions, I aim to highlight the varied challenges and operational dynamics that influence the adoption and use of drones by resistance forces in Myanmar.

5.1 Technological Challenges

Young, technophile individuals, including engineering students and defected soldiers with valuable military and technical expertise, are the strength of resistance forces in drone technology. These individuals now have established facilities for production and modification, trained another cohort as technical transfer, and have contributed to the proliferation of drone units across the country. However, the collected data expresses challenges such as the need for technical expertise and language barriers to access advanced training and production materials. Another important technical challenge is the enemy’s air defence system. Therefore, there are two technological challenges – one within the internal structure of resistance groups, and another one externally imposed by the enemy.

5.1.1 Internal Technological Challenges

As stated in the previous chapter, the strength of the resistance forces in drone technology stems from the involvement of young, tech-savvy individuals. These include engineering and technological students with expertise ranging from software to hardware and those with experience in mechanics. Many members are university students from Myanmar Aerospace Engineering University and other aerospace programs, contributing significant knowledge and skills to drone units. Those young students came to the ethnically controlled areas when massive crackdowns on the protests happened in 2021. At first, they set up production facilities for small arms and explosive munitions.

In addition, defected soldiers from the Myanmar Army who have joined the resistance movement bring valuable military and technical expertise. At first, these soldiers defected to join the Civil Disobedience Movement (CDM); later, when it shifted to an armed resistance movement, they supported young protesters with basic military training and tactics. Known as the "People's Soldier," these defectors have established production facilities and supported other groups nationwide. Among them are army engineering officers and graduates from the Defense Technological Academy, further bolstering the resistance's technological capabilities. The Radio Free Asia's Myanmar Program broadcasted in June 2022 highlighted that some defectors brought technical manuals when they left their organisation (RFA Burmese, 2022; တိုက်ခိုက်ရေးအတွက် CDM စစ်တပ်အရာရှိတွေ လက်နက်ထုတ်လုပ်နေ, 2022).

Based on available Facebook data, I found numerous drone production units actively involved in the resistance effort. Out of the 129 Facebook pages I examined between January 2021 and June 2024, 49 pages indicated having production facilities. The data shows a significant increase in drone production and modification facilities, particularly between July and December 2023.

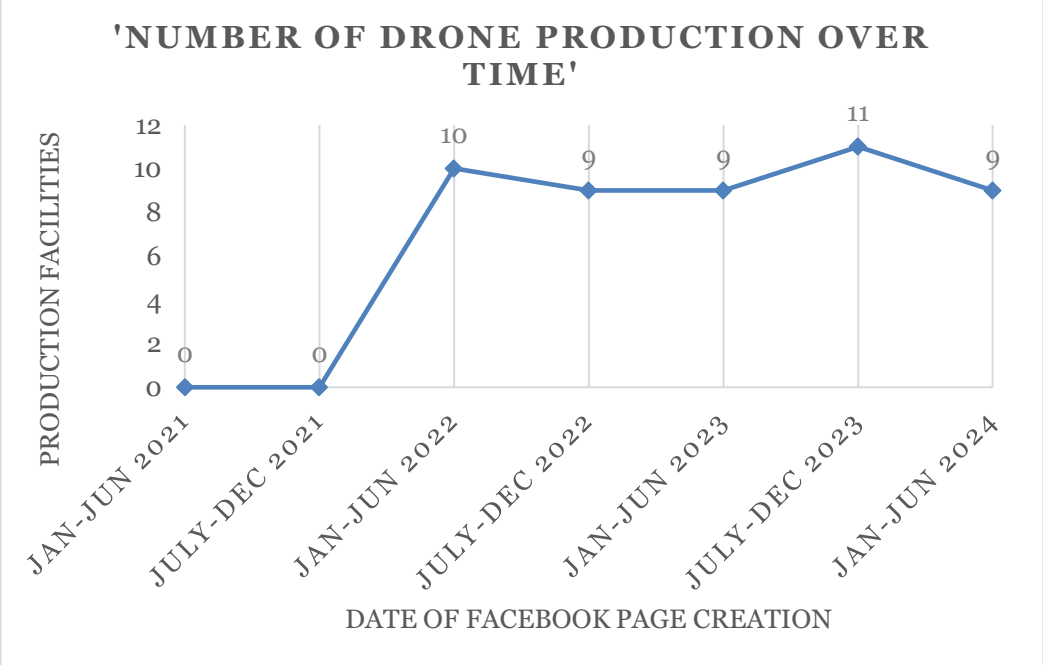

Figure 5-1 Number of Drone Units with Production Facilities (Based on available Facebook Data)

The highest number of drone units is in the Sagaing region, with 69 of which 15 have production facilities. This is followed by the Karen State, where ten units have production facilities. This highlights the concentration of drone production capabilities in these key regions, reflecting the strategic importance of these areas in the resistance movement. See the charts below.

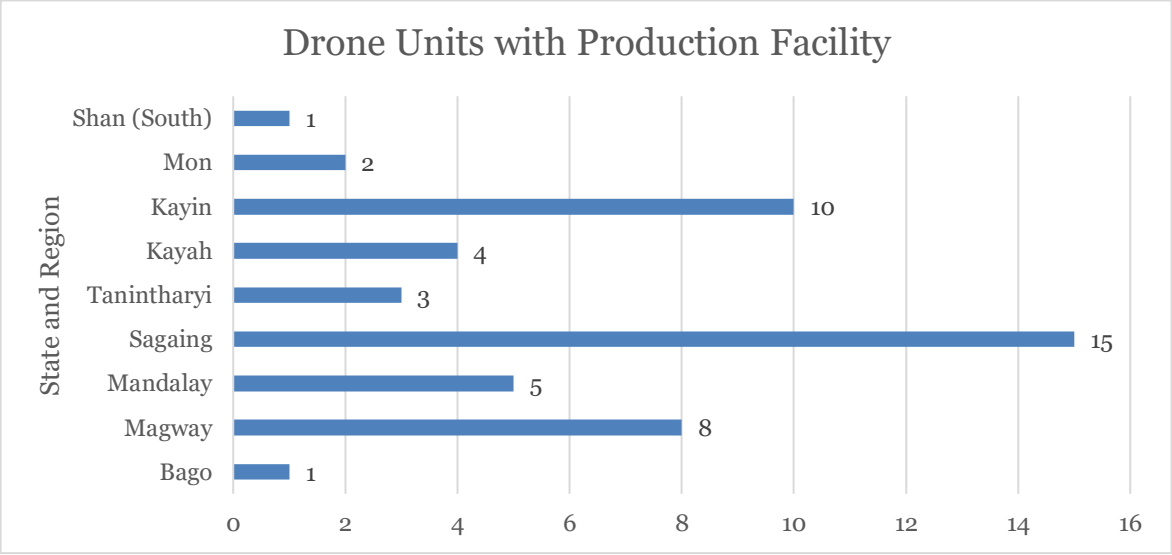

Figure 5-2 Drone Units with Production Facility in States and Regions

According to all 15 of my respondents, drone facilities owned or operated by resistance forces do not receive any foreign assistance. However, it is important to note that they need and want such assistance. Particularly, the groups in Karenni (Kayah) State explicitly stated that they were inspired by the Ukrainian resistance and strongly desired to learn from Ukrainian forces to gain access to more effective and advanced technology and technical expertise. This need for advanced technology and expertise represents a significant technological challenge for the current resistance forces. One of the respondents, an analyst on weapon systems in the region, stated that the drones used by the PDF are still evolving. However, they are not yet at a militarily advanced level, and there is a strong need for improvement.

Although they need this advanced technology and expertise, they are trying to fill the gap through internal technical transfer among the various groups within the country. Resistance forces focus on internal technical transfer to address the advanced technology and expertise gap. This process occurs through three main methods:

1. **Recruitment:** Each drone unit recruits new members from within the country, bringing fresh talent into the organisation. However, recruitment itself poses a significant challenge. Operating drones, from initial use to end use, is a complicated matter requiring basic knowledge of technology. Therefore, drone units prefer to recruit individuals with a foundational understanding of technology. Although this detail wasn't part of my formal data collection, while browsing Facebook , I observed a post about a massive recruitment effort by a drone force in Shan State, highlighting the importance and scale of recruitment efforts.

2. **Training:** Established drone units train newer units, sharing knowledge and skills to ensure consistency and effectiveness in drone operations.
   - Internal Unit Training: Founding or leading members of each drone unit provide training to the next generation within their own command.
   - Inter-Group Training: Less advanced groups receive training from more advanced groups, often in ethnic-controlled areas. Many drone groups in the Burma-dominated plain areas, especially in the Sagaing and Magway regions, reported receiving training in these ethnic areas.

- NUG-Provided Training: Technical experts sent by the NUG Ministry of Defense provide training to PDF-controlled areas, particularly in the central and western regions, including Sagaing, Magway, and Mandalay.

3. **Device Distribution:** The most commonly found method of technical transfer is the distribution of drones and related devices. More advanced units produce and distribute drones and related devices to other units, enabling them to utilise the technology even if they lack the capacity to produce it themselves.

Despite these strengths, several technological challenges persist. One primary challenge is the language barrier. Most advanced training materials, tutorials, and online resources are in English, which can hinder understanding and implementation. This barrier often requires additional effort to translate and comprehend the necessary information, slowing the learning and deployment process. In the early stages of using drones, from late 2021 to early 2022, even though the leaders of these drone units were familiar with technology, they struggled with the English manuals that came with drones shipped from abroad. They often had to seek translation support from individuals who could read English well. However, some translators were not from a technological background, adding another difficulty layer. This was highlighted by one of my interview respondents, an anti-junta activist involved in the early stages of the drone acquisition and program. That respondent mentioned that the experience as a translator, despite lacking a technical background, made the process even more challenging. That respondent gave a remark on this language and technology matter as follows,

“I think this (language) problem might be a huge issue to the groups in Bama Pyay (Bamar dominated, plain areas) because exposure to the English language is relatively lower than our place (ethnic areas).”

5.1.2 External Technological Challenge: Countermeasures

An analyst on regional issues noted that the drones employed by the resistance forces are not military-grade and have some technological drawbacks; however, they are effective in harassing their enemy. The analyst shared their observations, stating, "Myanmar Armed Forces, especially when they started experiencing the drone attacks from the resistance forces, were really shocked. It was obvious in analysing the Telegram channels of Myanmar

military supporters. The first reported drone attack was in Shwebo of Sagaing Region in late 2021. The Myanmar army didn't prepare for such an attack. However, after several drone attack experiences, they started using jammers."

The regime has acquired and deployed drone jammers of varying sizes and power, from portable backpack units to larger vehicle-mounted or static base defence systems. These jammers disrupt the radio frequencies used to control drones, making them difficult or impossible to operate. Their effectiveness has led to increased drone losses for resistance forces, particularly in 2023. Another countermeasure is using GPS spoofers to interfere with the drone's navigation system, which can potentially cause the drone to become disoriented and crash. At a broader level, the Myanmar military has adopted anti-drone technology in their strategic locations.

Furthermore, the military employed drone attacks as a countermeasure. The most notable event was the use of drones in Hsihseng of Southern Shan State. Pa-O, the dominant ethnic group in the town area, reported that military drone attacks resulted in the mass destruction of civilian properties. A journalist mentioned that the Myanmar military now has an official command office, the Drone Directorate, which likely receives assistance from Russia to train its personnel in drone operation and counter-drone tactics.

However, analysts remarked that the resistance drone forces were also unprepared for the regime's response. Seven anti-junta activists and journalists who participated in this research confirmed the unpreparedness for the regime's countermeasures. Some activists shared stories of the psychological impact on their combat personnel when they encountered the Myanmar military's counter-drone programs on the battlefield. Despite this, they argued that the regime's reaction prompted the resistance forces to upgrade their drone programs. As of data collection time, the advancement of drone types has reached the in-house production of VTOL and Kamikaze Suicide Drones . As they pursue these upgrades, the systems become more sophisticated and require more resources. The challenge of resource constraints will be explained in the following sub-section.

5.2 Financial Limitations and Resource Constraints

Drone operations have not always been successful. According to activists and based

on viral posts on Facebook, it is evident that drones sometimes crash due to technical problems or are shot down by the Myanmar military. Even in the face of such errors, resistance forces strive to recollect and refabricate the crashed drones. This is necessary because drones are very expensive. For example, even a small DJI reconnaissance drone with limited payload capability can be quite costly.

One diaspora activist mentioned that the drones used in Karenni State can cost between THB 200,000 to THB 300,000 (USD 2,000 to USD 5,000) per drone before shipping fees. This highlights the significant financial limitations faced by the resistance forces. As a result, they need to engage in extensive fundraising programs to support their drone operations.

Another significant factor contributing to financial limitations is the foreign currency exchange rate, which flew out of control after the military coup in Myanmar. This has greatly affected those groups that rely on the Myanmar currency or financial contributions from local supporters. The fluctuating exchange rate has made procuring necessary equipment and maintaining ongoing operations even more challenging.

Additionally, the financial resource availability for resistance groups has been enormously impacted by Myanmar's banking crisis and economic instability. Following the military coup, many resistance forces relied on funding from the local population. However, the economic crisis in the country has made it increasingly difficult for the local population to provide sustainable funding. The banking crisis has further exacerbated the issue, with a severe cash flow problem making it difficult to obtain real cash. Although online payments are easier, the regime has implemented a massive crackdown on crowdfunding activities using local mobile payment systems, further restricting the financial resources available to the resistance.

In addition to financial constraints, logistical issues present another major challenge, significantly impacting resource availability. There are two main logistical constraints:

1. Internal Restrictions: The Myanmar military has imposed numerous restrictions on the flow of goods and transportation amidst the intensifying conflict. These restrictions create significant obstacles for the resistance forces, making moving drones and essential parts within the country difficult.

2. External Controls: External constraints exist, particularly the control over drone exports from neighbouring countries like China and Thailand. These controls limit the ability to import drones and related technology, further complicating the logistical efforts to equip the resistance forces.

Moreover, geographic and location-based challenges further exacerbate these issues. Most ethnic areas lack basic infrastructure, especially reliable electricity and transportation networks, significantly impacting drone production, maintenance, and deployment. This lack of infrastructure leads to additional costs for buying generators and other necessary resources. Another challenge is the communication network, as the Myanmar military has imposed internet shutdowns in areas with intensified armed resistance, further complicating coordination and operations. These logistical hurdles exacerbate the resource constraints the resistance forces face, making it increasingly challenging to sustain their drone operations.

Differences in Drone Adoption

The above challenges have created significant differences in drone adoption among resistance forces across various regions in Myanmar. By examining three distinct regions—Karen State, Karenni State, and the central plain regions, including Sagaing and Magway—we can better understand how geographic, economic, and logistical factors influence the deployment and effectiveness of drone technology. Each region presents unique circumstances that shape their approach to utilising drones in the resistance movement.

According to the interviews, the main differences in drone models employed on the battlefield are due to the geographic terrain and the availability of resources. In regions with rugged and mountainous terrain, such as Karen State and Karenni State, resistance forces tend to use drones better suited for difficult landscapes. These drones often have enhanced navigation capabilities and robust designs to withstand harsh conditions. In contrast, the types of drones used often differ in central plain regions like Sagaing and Magway, where the terrain is flatter and more open. These regions may prioritise drones with longer flight ranges and higher payload capacities, better suited for expansive and open environments. However, due to the logistical challenges expressed above, the resource is more limited to those in central plain regions, and drone adoption is at a higher cost. Therefore, they rely on in-house production facilities to modify acquired drones.

While the motivation and patterns of drone use remain similar across the regions, the main difference is the number of drones employed on the battlefield. One of the activists noted that some units have produced and deployed hundreds of drones on the battlefield in Karen State. This is due in part to their successful crowdfunding efforts and community support. Conversely, in some areas of the central plain regions, resistance units might have only two to three drones ready for deployment, with some units having up to ten at most. These discrepancies highlight the varying levels of resource availability and fundraising success across different regions. Therefore, how these regions raise funds and conduct crowdfunding becomes another significant difference. Before looking into the differences in the crowdfunding activities of the groups, I will first provide the background on the crowdfunding pattern in post-coup Myanmar.

5.3 Pattern of Crowdfunding

Crowdfunding in Myanmar is not a new concept, though it has only become prevalent in the post-coup period. There is literature on social welfare programs of civil society organisations in Myanmar; however, there are only two sources – an analysis published by Diplomat magazine and the International Crisis Group's Report on crowdfunding in Myanmar (Abuza, 2022; *Crowdfunding a War: The Money behind Myanmar's Resistance | Crisis Group*, 2022). Before the coup, the term "fundraising" was widely used among civil society organisations in Myanmar. Fundraising patterns within Myanmar's civil society were primarily through donations and heavily based on community support. For example, specific communities, such as those in urban or rural areas, often contribute to social welfare groups established by local people. These donations were used to support various community projects and social initiatives. In the post-coup environment, the need for financial support has dramatically increased, and the methods of obtaining it have evolved. The term "crowdfunding" describes the more organised and widespread efforts to gather funds from a broad base of supporters.

In December 2022, the International Crisis Group (2022) report highlighted the long-term role of crowdfunding activities in Myanmar's anti-junta resistance groups and outlined the methods employed by these resistance groups to raise funds. In the early days of the coup, crowdfunding involved organising online campaigns and selling items such as books, accessories, and paintings. The money collected from these activities was then funnelled to

activist groups. As the armed resistance evolved, these crowdfunding activities remained largely unchanged. They continued to rely on the local population's support, organising similar fundraising efforts to sustain their operations. This method has been crucial in providing the financial resources needed to support resistance activities, including the deployment and maintenance of drone technology.

However, the need for fundraising increased significantly because the cost of munitions and firepower is high and demanding, and the country's economic hardship hinders the ability to gather funds. According to the International Crisis Group (2022) report, a resistance force noted that donations from local supporters dropped by half one year after the coup. This decline was attributed to economic hardship and the imposition of restrictive mobile banking rules, regulations, and criminalisation.

Young people devised innovative solutions to overcome these challenges, including fundraising projects through clickbait activities. In late 2021 and early 2022, they organised campaigns like "Click to Donate" or "Click for PDF[4]," encouraging people to watch YouTube videos to reach a billion views. They created challenges involving fans of pop culture, such as K-pop groups. For instance, Myanmar BTS fans, known as ARMY (not to be confused with the military), participated in viewing campaigns to generate revenue from YouTube[5]. These campaigns reached milestones like one billion views, turning viewership into monetary support for the resistance forces. Similar campaigns were conducted throughout 2021, leveraging the power of pop culture fandoms to raise funds.

Another type of fundraising involves developing game applications usable on both iOS and Android platforms. Some IT professionals and data programmers have created websites where users can watch advertisements, generating revenue through these views. This clickbait pattern has been quite effective. They also organised daily challenges for users to engage with these platforms. One popular game is "PDF Games," which has become a significant part of their fundraising efforts. These innovative approaches have provided new avenues for raising funds, leveraging technology and user engagement to support the

[4] From my own dataset
[5] 1 Billion View Campaign with BTS ARMY

resistance forces.

The latest fundraising method these groups use is the Facebook Bonus Program. This program allows pages with significant followers to monetise their content through interactions such as comments, reactions, and shares on each post. The Facebook Bonus Program is selectively offered to certain pages, making it a valuable resource for those who can access it. Through this program, resistance groups have found a new way to generate funds by leveraging their online presence and follower engagement.

Although independent young people spearhead the above fundraising activities, significant crowdfunding activities are organised by the parallel entity, the National Unity Government (NUG). When the NUG was founded on April 16, 2021, they introduced the "Spring Lottery," which aimed to replace the National Lottery System controlled by the junta. This lottery program successfully raised substantial funds. The NUG also issued government bonds, further bolstering their financial resources.

In Myanmar, mobile banking poses significant risks for supporters of resistance groups. If the government discovers that a particular person is financially supporting these groups, their bank account can be immediately banned or closed, creating a major obstacle to fundraising activities.

To address this challenge, the NUG created a platform called NUG Pay, which supports multiple currencies, including the Myanmar kyat, Thai baht, and US dollar. NUG Pay also provides exchange services to offer advice on exchange rates and facilitate currency conversion. Unlike traditional banking, NUG Pay functions as a transaction-based application, allowing users to conduct financial transactions securely without the risk of government intervention. This platform has become a crucial tool for sustaining fundraising efforts and financially supporting resistance.

In 2022, the NUG introduced a banking system called Spring Development Bank. This system allows people to conduct transactions, save, and do more. Both Spring Development Bank and NUG Pay support traditional currencies and cryptocurrencies, including DMMK. These platforms have provided innovative financial solutions to bypass government restrictions and support the resistance financially.

Additionally, the NUG announced ambitious projects, such as selling condos and launching city development projects in Yangon. They promised that these projects would be implemented after the revolution, and people who invested money now would receive a room or property in return. This forward-thinking approach aimed to garner immediate financial support with the promise of future rewards.

One of the NUG's most creative and effective fundraising programs was pinning the location of military leader Min Aung Hlaing's house in Yangon on Google Maps and organised a bidding process. Participants who bought tickets could own the house after the revolution. This campaign raised significant funds and captured public attention and support.

However, although these activities are very creative and represent a new form of crowdfunding for Myanmar, the way the NUG manages the funds raised has not always been effective. The transition process to transfer the raised funds to the groups on the ground often takes time, hindering immediate support for resistance efforts. Consequently, people on the ground still rely heavily on traditional crowdfunding methods from the local population.

Moreover, even traditional crowdfunding methods have seen creative adaptations. For example, resistance groups have created raffle tickets and online concert tickets with set minimum donations. These creative approaches to traditional fundraising methods have helped maintain and boost financial support from the local population. By organising online concerts and other virtual events, they have managed to engage a wider audience and sustain a steady flow of funds to support their activities. Despite the country's economic hardship, contributions from the local population have consistently been the highest compared to those from the Myanmar diaspora community worldwide.

Speaking of the diaspora community, there are two main types of contributions. The first is from migrant workers working in neighbouring countries and abroad. For example, migrant workers in Thailand, Malaysia, Japan, and South Korea regularly contribute to the armed resistance efforts. The second type of contribution comes from the ethnic diaspora community. These groups play a significant role in supporting the resistance, providing financial resources and raising international awareness about the situation in Myanmar.

The next section discusses how crowdfunding patterns differ from region to region and their impact on the limitation of financial resources for drone units.

5.4 Case Study: Crowdfunding in Selected Regions

Case of the Karen State: The drone units in Karen State can be considered the most resourceful compared to those in other regions. This is largely due to their multiple fundraising channels, which are bolstered by their advantageous geographic location. Karen State's immediate proximity to the border with Thailand provides these units with direct access to cross-border support and resources. This strategic location allows them to tap into various fundraising opportunities more effectively, contributing to their relative resourcefulness.

In addition to this geographic advantage, the Karen State has become a central hub for resistance activities. When young people across Myanmar chose to take up arms, Karen State was often their first choice for basic military training. This has made the region a home base for numerous resistance groups, attracting fighters from different parts of the country. These fighters bring their own networks, including connections with diaspora communities, further enhancing their fundraising capabilities.

Moreover, the Karen State has a significant role in the broader resistance movement. Many NUG members took refuge in Karen State following the coup. This has fostered a close bond between the NUG, the PDF forces in the Karen State, and the Karen National Union (KNU). The strong relationship between these groups has facilitated better coordination and resource sharing, making Karen State a vital centre for resistance efforts.

The Case of the Karenni State: The fundraising dynamics are somewhat different in Karenni State. Many of the armed resistance groups in Karenni State operate independently and are not clearly under the NUG chain of command. This independence influences their fundraising strategies, leading them to rely heavily on their diaspora communities. The Karenni, Kayah, and other ethnic groups have established strong diaspora communities across various foreign countries. These communities provide crucial financial support, organising fundraising programs to aid the resistance efforts back home.

Regarding fundraising for the drone units, they follow a distinct approach. Drone production units do not directly engage in fundraising activities; these efforts are typically handled by affiliated parties such as political wings, higher-level departments, or dedicated

fundraising teams. However, drone units participate in fundraising efforts when there is a need to attract more attention or create impactful campaigns. They do this by sharing videos, participating in talks, and engaging with the public, thereby enhancing the effectiveness of the fundraising programs they are associated with.

The latest fundraising program in Karenni State involves creating products for daily use, specifically targeting customers within the diaspora community. One such project involves producing and selling dry tea leaves for traditional Myanmar tea. These products are sold in various countries, including Australia, the United States, Thailand, and some European countries, providing steady funds to support their resistance efforts.

The Case of Plain Region: Fundraising and crowdfunding in the plain region differ notably from other areas. In the plain region, resistance groups do not have the established rebel economy or governance structures in ethnic-controlled areas. These resistance groups are relatively new; therefore, they have not developed the capacity to implement rebel economy practices, such as taxation, within their control areas.

From the very beginning of their formation, these groups have relied heavily on support from the local population, particularly through close connection donations. One of my respondents mentioned that while they have attempted to launch fundraising programs targeting the diaspora community, most of their funding still comes from local supporters. The strong connection with the local population remains their primary source of financial support.

The above case study on fundraising does not have a limit to the drone modification or production process. The following section presents the findings for the fundraising campaigns for drones from Facebook data collection.

5.5 Differences in Fundraising Campaigns for Drones

This section highlights the differences in fundraising campaigns for drones based on data collected from Facebook. Out of 129 pages representing drone units, I have identified 38 distinct fundraising campaigns on Facebook. These campaigns are particularly concentrated in three regions: the southern, the eastern, and the western or central regions. For those campaigns, I analysed the timeline of the campaigns starting from July 2022. I

divided the campaigns into four-time intervals: July to December 2022, January to June

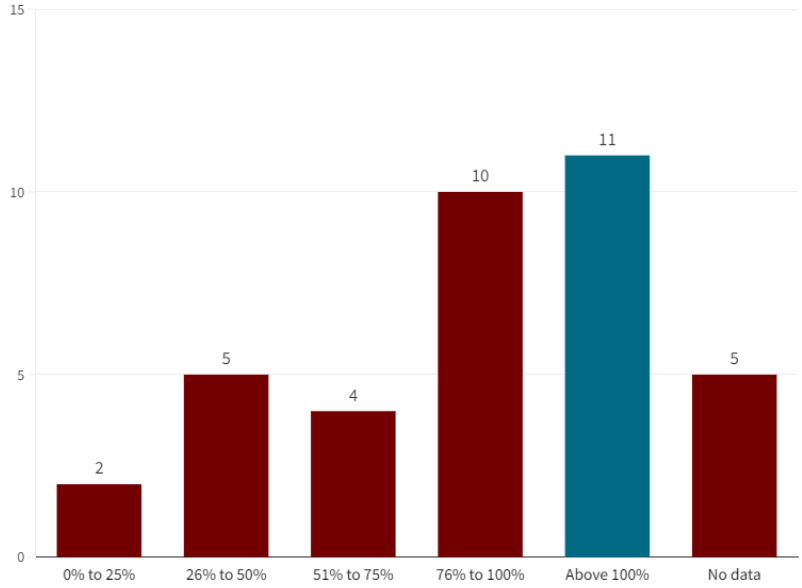

Figure 5-3 Number of Campaigns for Drones and Final Result

2023, July to December 2023, and January to June 2024. In my analysis, I also categorised the campaigns based on whether they reached their target amounts. The following chart shows that 11 out of 38 campaigns reached over their targeted fundraising amount.

However, the following graph (Figure5-4) shows that the campaigns went beyond the target happened most in 2024.

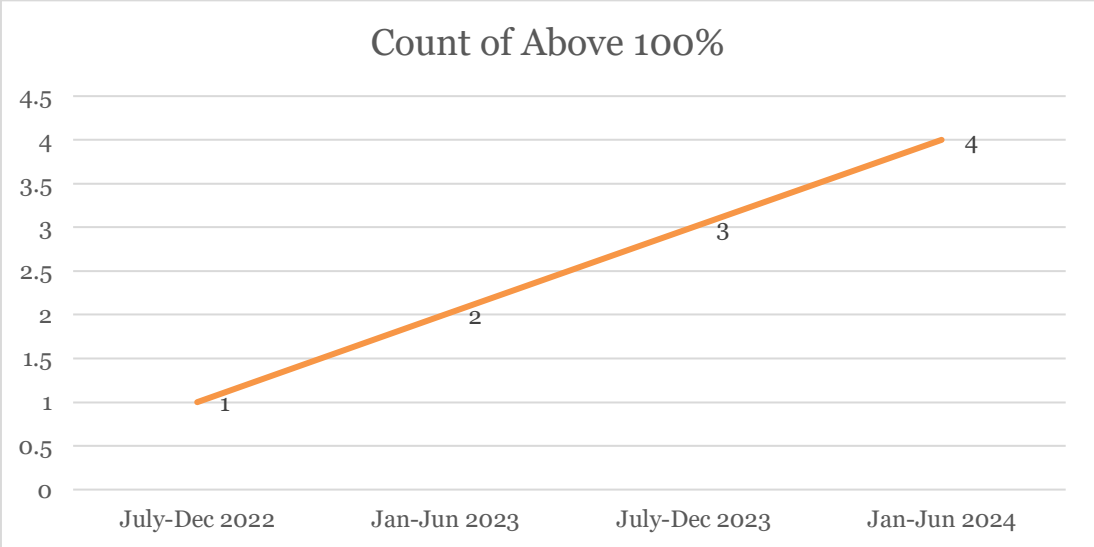

Figure 5-4 Campaigns that reached over 100% of the target amount between July 2022 and June 2024

From this analysis, I found that in the Eastern region, particularly in Karenni State, most campaigns did not reach the target amounts they announced on Facebook. This indicates a difference in the effectiveness of fundraising efforts across the regions. For the southern region, the success of reaching campaign targets is consistent across the different intervals. The likelihood of reaching their targets appears roughly the same throughout the campaign. On a side note, I found a gap in the duration of campaigns because some campaigns reached their target only after an extension. However, those groups did not disclose such data.

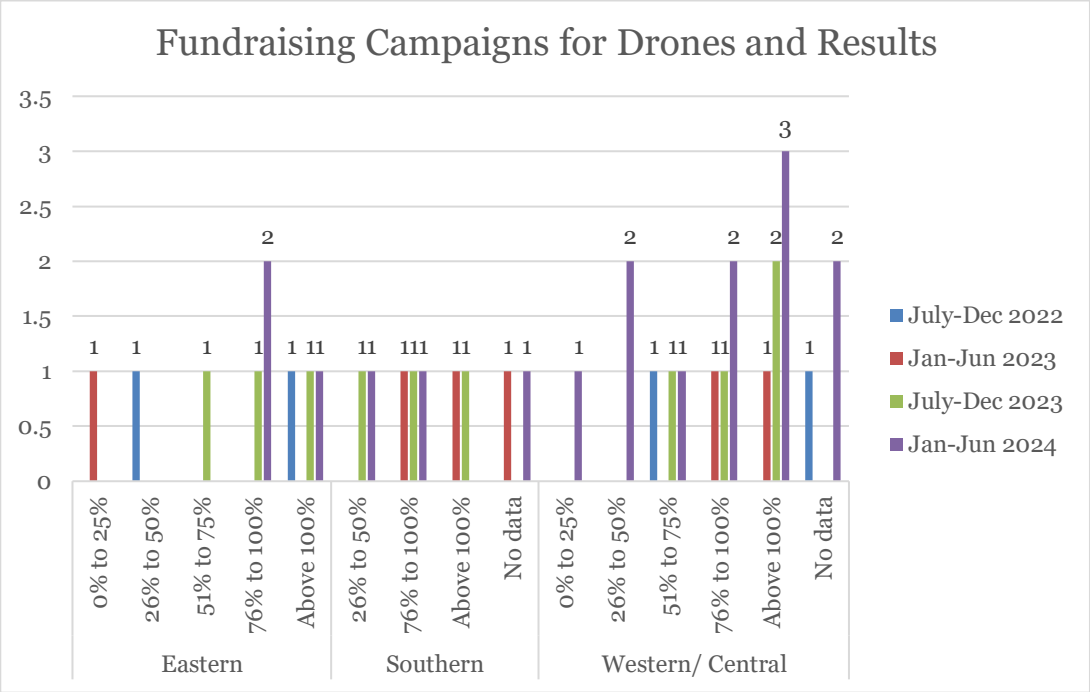

Figure 5-5 Comparison of Fundraising Campaigns for Drones

From this data, financial resources become more available (more donations and support) starting mid-2023. Although plain regions have more challenges in terms of technological and logistics aspects, receiving support beyond their target can be assumed that their drone units receive increased public support. The next chapter discusses the strategic deployment of drones and the implications on the conflict dynamics.

6 Implication and Conclusion

6.1 Implication

The use of drones has significant implications for Myanmar's armed conflict dynamics. Based on the fundraising data, it can be assumed that the public supports and recognises the importance of drone technology in the resistance efforts. The consistent fundraising efforts and the public's willingness to contribute suggest that the use of drones is not only seen as a tactical advantage but also as a symbol of the broader resistance movement. The data indicates that the adoption of drone technology has garnered substantial public backing, which plays a crucial role in sustaining and advancing these efforts.

Additionally, literature uniformly suggests that the use of drones by national actors operates at a strategic level, often serving as a powerful tool for propaganda. This is largely due to the dual-use nature of drone technology—drones can be used for attacks and capture and broadcast victories from the battlefield, offering an aerial perspective that enhances their impact. In the case of Myanmar, social media has been flooded with videos showing drone strikes, often depicting members of the Myanmar military fleeing or reacting in fear after a bomb is dropped. My respondents uniformly stated that the use of drones has a significant psychological impact on the resistance forces' enemies, particularly the Myanmar military.

Moreover, the use of drones has the potential to alter the conflict dynamics in the country significantly. By providing resistance forces with a technological edge, drones can shift the balance of power on the battlefield, enabling more precise and strategic operations. This technological advantage enhances the effectiveness of resistance efforts and challenges the traditional tactics and strategies employed by the Myanmar military. As a result, drones are becoming a crucial factor in reshaping the ongoing conflict.

In April 2024, resistance forces, particularly those under the NUG chain of command, demonstrated their capability to harass Myanmar military air bases using a number of fixed-wing drones (မျိုးမင်း (မကျည်းလဟာ), 2024). One notable attempt was the attack on the Naypyidaw airbase, located in Myanmar’s capital and a crucial stronghold for the junta. According to information released during a press conference organised by the State Administration Council, the NUG sent a dozen fixed-wing drones armed with explosive devices to target Myanmar Air Force fighter jets at the Naypyidaw airbase. Despite the sophistication of the operation, the Myanmar military's air defence system was activated and intercepted the attack, shooting down 13 drones before they could reach their targets. While

the attempt did not achieve its intended outcome, it highlighted the NUG's growing tactical ambitions and the potential for drones to play a disruptive role in the conflict, even against heavily fortified targets like airbases. In addition, it received widespread public support and praise. Many supporters hailed the event as a significant milestone, stating that the resistance forces now had their form of "air force[6]" capable of challenging the junta's dominance in the skies. This sentiment underscores drone technology's symbolic and strategic importance in the ongoing conflict.

By examining the current use of drones by the new resistance forces, it is clear that they employ this technology for various strategic purposes, including reconnaissance, targeted killings, and harassment of regime troops. Additionally, drones are now being used to achieve broader strategic goals, such as influencing public perception and morale. Rather than "propaganda," a more positive term might be "strategic communication" or "information operations," as these efforts are aimed at shaping the narrative and demonstrating the resistance's capabilities to both their supporters and adversaries.

Meanwhile, the Myanmar military has also been utilising drones as a countermeasure, deploying models that are more sophisticated, advanced, and militarily graded compared to those used by the resistance forces. The proliferation of these countermeasure drones by the Myanmar military has become increasingly evident in 2024. According to open-source reports, there is widespread speculation that the military possesses superior drone technology, giving them an advantage over the drones used by the armed resistance forces.

In addition to deploying sophisticated drones, the Myanmar military has established defence systems capable of intercepting and neutralising drone threats. However, it remains unclear whether the resistance forces have begun developing strategies to counter or deter the Myanmar military's advanced countermeasure drones. If and when the resistance forces address this challenge, the technological arms race within the conflict will significantly escalate.

[6] Interview Data

Although there has been extensive journalistic reporting on the use of drones by the resistance forces and the Myanmar military, further study is needed to consider the proliferation of drones by Ethnic Armed Organizations (EAOs). A recent example is Operation 1027, a joint operation between the Three Brotherhood Alliance, which includes the Ta'ang National Liberation Army (TNLA), Arakan Army (AA), and the Myanmar National Democratic Alliance Army (MNDAA) (Inside 'Operation 1027', the anti-junta offensive in Myanmar, 2023; Michaels, 2024). These groups have been fighting against the Myanmar military, particularly in the northern Shan State.

Analysts specialising in regional conflicts and warfare have commented that Operation 1027 marked a significant defeat for the Myanmar military—potentially the most severe loss in their history. Two analysts highlighted that the MNDAA used military-grade drones equipped with advanced technology and deployed them in swarming formations as part of a coordinated and well-planned attack. This tactic profoundly impacted the battlefield, altering the dynamics of the conflict. One analyst mentioned that these drones were strategically employed first to target the logistical lines of the Myanmar military, followed by attacks on key military outposts. As a result, the Myanmar military was severely hindered in maintaining their logistical supply lines, contributing to their defeat.

During Operation 1027, the MNDAA's use of drones was notably impactful. BBC Burmese was the only outlet to report on how members of the Myanmar military, particularly the soldiers, felt frustrated and devastated when confronted with the effectiveness of these drones (BBC Burmese, 2023). The report highlighted that this experience led some within the military to start questioning whether the use of drones by resistance forces, including Ethnic Armed Organizations like the MNDAA, could significantly change the conflict dynamics and alter the asymmetrical warfare situation in Myanmar.

The Myanmar military, or the military regime, accused the MNDAA of using drones that were made in China, suggesting that these drones were technologically advanced enough to evade the Myanmar military's drone defence systems, including jammers—in an interview with BBC Burmese, Myanmar military personnel expressed surprise at encountering such advanced technology in the hands of an Ethnic Armed Organization. While they accused the MNDAA of receiving foreign support for this technological assistance, they did not explicitly disclose or confirm who the foreign actor might be.

During Operation 1027, some drone units from the southern region joined the operation. One such drone unit member called Cloud Wings shared their experience with the media, where he mentioned that their drones were continuously in operation. He stated, "We haven't taken a day off to date. There hasn't been a single day or night without a drone strike."

6.2 Conclusion

It is very clear that the involvement of various armed actors in Myanmar, all utilising drone technology, is reshaping the conflict landscape. As one analyst noted, "It is only a matter of time." It is only a matter of time before all sides in the conflict fully harness the potential of drone technology. During this period, each side will likely have the space to advance their technology, prepare strategically, and train their forces for increasingly sophisticated operations. However, the pace and success of these advancements will largely depend on resource availability. Access to funding, materials, and skilled personnel will be critical factors in determining which side can most effectively utilise drone technology to their advantage.

In summary, the continued evolution of drone technology in Myanmar's conflict is inevitable, with all sides seeking to advance their capabilities. As they do so, the availability of financial and material resources will be pivotal in determining the effectiveness of these efforts. The conflict's trajectory may pivot on which side can better manage and sustain its technological and strategic advancements. Ultimately, it is not just a matter of time but also of resources that will shape the future of this conflict.

Bibliography

Abbott, C. *et al.* (2016) 'Hostile Drones: The Hostile Use of Drones by Non-State Actors against British Targets'.

Ackerman, S. (2011) 'Libyan Rebels Are Flying Their Own Minidrone', *Wired*, 23 August. Available at: https://www.wired.com/2011/08/libyan-rebels-are-flying-their-own-mini-drone/ (Accessed: 4 April 2024).

Al Jazeera (2023) *Myanmar military admits facing 'heavy assaults' from anti-coup forces*, *Al Jazeera*. Available at: https://www.aljazeera.com/news/2023/11/16/myanmar-military-admits-facing-heavy-assaults-from-anti-coup-forces (Accessed: 30 July 2024).

Ali, S.S., Kaur, R. and Khan, S. (2023) 'Identification of innovative technology enablers and drone technology determinants adoption: a graph theory matrix analysis framework', *Operations Management Research*, 16(2), pp. 830–852. Available at: https://doi.org/10.1007/s12063-023-00346-3.

Altman, D. (2015) 'The Strategist's Curse: A Theory of False Optimism as a Cause of War', *Security Studies*, 24(2), pp. 284–315. Available at: https://doi.org/10.1080/09636412.2015.1038186.

Anderson, L. (2023) 'Beyond the Lines: Social Networks and Palestinian Militant Organizations in Wartime Lebanon', *Foreign Affairs*, 22 August. Available at: https://www.foreignaffairs.com/reviews/beyond-lines-social-networks-and-palestinian-militant-organizations-wartime-lebanon (Accessed: 30 November 2023).

Andrejevic, M. (2016) 'Chapter 2: Theorizing Drones and Droning Theory', in A. Završnik (ed.) *Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance*. Cham: Springer International Publishing, pp. 21–43. Available at: https://doi.org/10.1007/978-3-319-23760-2.

Arjona, A. (2016a) 'Institutions, Civilian Resistance, and Wartime Social Order: A Process-driven Natural Experiment in the Colombian Civil War', *Latin American Politics and Society*, 58(3), pp. 99–122. Available at: https://doi.org/10.1111/j.1548-2456.2016.00320.x.

Arjona, A. (2016b) *Rebelocracy: Social Order in the Colombian Civil War*. Cambridge: Cambridge University Press (Cambridge Studies in Comparative Politics).

Available at: https://doi.org/10.1017/9781316421925.

Arjona, A. (2017) 'REBELOCRACY: A THEORY OF SOCIAL ORDER IN CIVIL WAR Ana Arjona'.

Arjona, A., Kasfir, N. and Mampilly, Z. (eds) (2015) *Rebel Governance in Civil War*. Cambridge: Cambridge University Press. Available at: https://doi.org/10.1017/CBO9781316182468.

Bakke, K.M. (2012) 'Rebel Rulers: Insurgent Governance and Civilian Life During War. By Zachariah Cherian Mampilly. Ithaca, NY: Cornell University Press, 2011. 320p. $45.00.', *Perspectives on Politics*, 10(4), pp. 1129–1130. Available at: https://doi.org/10.1017/S1537592712002642.

Balkan, S. (2019) 'A Global Battlefield? Rising Drone Capabilities of Non-State Armed Groups and Terrorist Organizations', *A Global Battlefield? Rising Drone Capabilities of Non-State Armed Groups and Terrorist Organizations* [Preprint]. Available at: https://www.academia.edu/41400412/A_Global_Battlefield_Rising_Drone_Capabilities_of_Non_State_Armed_Groups_and_Terrorist_Organizations (Accessed: 4 April 2024).

BALL, R.J. (2017) 'The Proliferation of Unmanned Aerial Vehicles: Terrorist Use, Capability, and Strategic Implications'. Lawrence Livermore National Laboratory.

Barkawi, T. (2016) 'Decolonising war', *European Journal of International Security*, 1(2), pp. 199–214. Available at: https://doi.org/10.1017/eis.2016.7.

Barsade, I. and Horowitz, M.C. (2017) 'Militant groups have drones. Now what?', 7 September. Available at: https://thebulletin.org/2017/09/militant-groups-have-drones-now-what/ (Accessed: 25 July 2024).

BBC Burmese (2023) *၁၀၂၇ စစ်ဆင်ရေးမှာ ဒရုန်းနဲ့ဘယ်လိုတိုက်ခိုက်လဲ (English Translation: How Drones were used during Operation 1027)*, *BBC News မြန်မာ*. Available

at: https://www.bbc.com/burmese/articles/c51e8kl0kleo (Accessed: 30 July 2024).

BBC World News (2015) 'Japan radioactive drone: Tokyo police arrest man', *BBC News*, 25 April. Available at: https://www.bbc.com/news/world-asia-32465624 (Accessed: 3 August 2024).

BBC World News (2018) 'Venezuela President Maduro survives "drone assassination attempt"', 4 August. Available at: https://www.bbc.com/news/world-latin-america-45073385 (Accessed: 3 August 2024).

Bennett, A. (2015) 'Using Process Tracing to Improve Policy Making: The (Negative) Case of the 2003 Intervention in Iraq', *Security Studies*, 24(2), pp. 228–238. Available at: https://doi.org/10.1080/09636412.2015.1036619.

Bennett, A. and Checkel, J.T. (eds) (2014) *Process Tracing: From Metaphor to Analytic Tool*. Cambridge: Cambridge University Press (Strategies for Social Inquiry). Available at: https://doi.org/10.1017/CBO9781139858472.

Bergen, P., Salyk-Virk, M. and Sterman, D. (2020) *World of Drones*, *New America*. Available at: http://newamerica.org/future-security/reports/world-drones/ (Accessed: 25 July 2024).

Boyle, M.J. *et al.* (2017) 'Debating Drone Proliferation', *International Security*, 42(3), pp. 178–182.

Boyle, M.J. (2020) *The Drone Age: How Drone Technology Will Change War and Peace*. Oxford: Oxford University Press. Available at: https://academic.oup.com/book/36688?searchresult=1 (Accessed: 25 July 2024).

Braithwaite, A. (2015) 'Transnational Terrorism as an Unintended Consequence of a Military Footprint', *Security Studies*, 24(2), pp. 349–375. Available at: https://doi.org/10.1080/09636412.2015.1038192.

Brenner, D. (2019) *Rebel Politics: A Political Sociology of Armed Struggle in*

Myanmar's Borderlands. Cornell University Press. Available at: https://www.jstor.org/stable/10.7591/j.ctvfc55nc (Accessed: 30 November 2023).

Brochert, H., Verbovszky, J. and Schütz, T. (2021) *Beware the Hype. What Military Conflicts in Ukraine, Syria, Libya, and Nagorno-Karabakh (Don't) Tell Us About the Future of War*. DAIO Study 21/01. Helmiy Schmidt University in Hamburg, Germany: Defense AI Observatory (DAIO). Available at: https://www.researchgate.net/publication/351614718_Beware_the_Hype_What_Military_Conflicts_in_Ukraine_Syria_Libya_and_Nagorno-Karabakh_Don't_Tell_Us_About_the_Future_of_War (Accessed: 25 July 2024).

Bunker, R.J. (2015) *Terrorist and Insurgent Unmanned Aerial Vehicles: Use, Potentials, and Military Implications*. Carlisle, PA: Strategic Studies Institute, U.S. Army War College. Available at: https://apps.dtic.mil/sti/citations/ADA623134 (Accessed: 10 June 2024).

Calcara, A., Gilli, A., Gilli, M., Marchetti, R., *et al.* (2022) 'Why Drones Have Not Revolutionized War: The Enduring Hider-Finder Competition in Air Warfare', *International Security*, 46(4), pp. 130–171. Available at: https://doi.org/10.1162/isec_a_00431.

Calcara, A., Gilli, A., Gilli, M. and Zaccagnini, I. (2022) 'Will the Drone Always Get Through? Offensive Myths and Defensive Realities', *Security Studies*, 31(5), pp. 791–825. Available at: https://doi.org/10.1080/09636412.2022.2153734.

Callahan, M.P. (2005) *Making enemies: war and state building in Burma*. Cornell University Press. Available at: https://hdl.handle.net/2027/heb09232.0001.001 (Accessed: 5 August 2024).

Chan, A.N. (2020) *AA accuses Tatmadaw of using combat drones*, *Myanmar Now*. Available at: https://myanmar-now.org/en/news/aa-accuses-tatmadaw-of-using-combat-drones/ (Accessed: 5 April 2024).

Chávez, K. and Swed, O. (2021) 'The proliferation of drones to violent nonstate actors', *Defence Studies*, 21(1), pp. 1–24. Available at:

https://doi.org/10.1080/14702436.2020.1848426.

Chávez, K. and Swed, O. (2023) 'Emulating underdogs: Tactical drones in the Russia-Ukraine war', *Contemporary Security Policy*, 44(4), pp. 592–605. Available at: https://doi.org/10.1080/13523260.2023.2257964.

Checkel, J.T. and Bennett, A. (2014) 'Beyond metaphors: Standards, theory, and the "where next" for process tracing', in A. Bennett and J.T. Checkel (eds) *Process Tracing: From Metaphor to Analytic Tool*. Cambridge: Cambridge University Press (Strategies for Social Inquiry), pp. 260–275. Available at: https://doi.org/10.1017/CBO9781139858472.014.

Cheesman, N. and Farrelly, N. (eds) (2016) *Conflict in Myanmar: War, Politics, Religion*. ISEAS–Yusof Ishak Institute (Lectures, Workshops, and Proceedings of International Conferences). Available at: https://www.cambridge.org/core/books/conflict-in-myanmar/C6DECD3D02D4FA41EA7C0BDD1F6CC3C3 (Accessed: 5 August 2024).

Choi-Fitzpatrick, A. (2014) 'Drones for Good: Technological Innovations, Social Movements, and the State', *Journal of International Affairs*, 68(1), pp. 19–36.

Christian Science Monitor (2014) 'Drones in the hands of Hamas: How worrisome is that?', 18 July. Available at: https://www.csmonitor.com/USA/Military/2014/0718/Drones-in-the-hands-of-Hamas-How-worrisome-is-that (Accessed: 10 June 2024).

Clash Report [@clashreport] (2024) 'FPV drones arrive in yet another war.', *Twitter*. Available at: https://x.com/clashreport/status/1786284156403552306 (Accessed: 30 July 2024).

CNI (2024) *MNDAA launches offensive against SSPP by bombing over 50 times with drones*, *cnimyanmar.com*. Available at: https://www.cnimyanmar.com/index.php/english-edition/21298-mndaa-launches-offensive-against-sspp-by-bombing-over-50-times-with-drones (Accessed: 30 July 2024).

Cronin, A.K. (2020) *Power to the People. How Open Technological Innovation is Arming Tomorrow's Terrorists*. Oxford: Oxford University Press.

Dafoe, A. (2015) 'On Technological Determinism: A Typology, Scope Conditions, and a Mechanism', *Science, Technology, & Human Values*, 40(6), pp. 1047–1076.

Davis, A. (2023) *The dangers of guerrilla triumphalism in Myanmar*, *Asia Times*. Available at: http://asiatimes.com/2023/12/the-dangers-of-guerrilla-triumphalism-in-myanmar/ (Accessed: 30 July 2024).

De Pascale, A. (2024) 'Drones: Burma's new rebel front', *Atlas of wars*, 12 February. Available at: https://www.atlasofwars.com/drones-burmas-new-rebel-front/ (Accessed: 30 July 2024).

Di Cosmo, N., Fassin, D. and Pinaud, C. (eds) (2021) *Rebel economies: warlords, insurgents, humanitarians*. Lanham: Lexington Books.

Droning America: The Tech Our Enemies Can Buy (2013). Available at: https://warontherocks.com/2013/10/droning-america-the-tech-our-enemies-can-buy/ (Accessed: 10 June 2024).

Dunning, T. (2014) 'Improving process tracing: The case of multi-method research', in A. Bennett and J.T. Checkel (eds) *Process Tracing: From Metaphor to Analytic Tool*. Cambridge: Cambridge University Press (Strategies for Social Inquiry), pp. 211–236. Available at: https://doi.org/10.1017/CBO9781139858472.012.

Eleven Media (2024) *30 dead, 55 injured in drone and bomb attacks in Myanmar, Including children*, *The Nation Thailand*. Available at: https://www.nationthailand.com/news/asean/40040068 (Accessed: 30 July 2024).

Elman, C. and Owen, J.M. (2015) 'Symposium on Process Tracing: Note to Readers', *Security Studies*, 24(2), pp. 199–199. Available at: https://doi.org/10.1080/09636412.2015.1036580.

Fassin, D. (2021) 'What are non-state war economies? Prefatory Remarks', in N. Di Cosmo, D. Fassin, and C. Pinaud (eds) *Rebel economies: warlords, insurgents, humanitarians*. Lanham: Lexington Books.

'"For comparison, in Operation 1027, we deployed our teams only on the night of 25 November. Since we entered the combat zones on the night of 26 November, we haven't taken a single day's break to date. There hasn't been a single day or night without drone strikes…" - Ko Nyein, in charge of Cloud Wings drone force » Myanmar Peace Monitor' (2023) *Myanmar Peace Monitor*, 24 November. Available at: https://mmpeacemonitor.org/324312/for-comparison-in-operation-1027-we-deployed-our-teams-only-on-the-night-of-25-november-since-we-entered-the-combat-zones-on-the-night-of-26-november-we-havent-taken-a-single-day/ (Accessed: 30 July 2024).

Franke, U. (2016) *Flying IEDs: The Next Big Threat?*, *War on the Rocks*. Available at: https://warontherocks.com/2016/10/flying-ieds-the-next-big-threat/ (Accessed: 25 July 2024).

Free Rangers Burma (2024) *Operation 1027 Gives Tangible Hope for Change in Northern Burma | Free Burma Rangers*, *Free Ranger Burma*. Available at: https://www.freeburmarangers.org/2024/02/14/operation-1027-gives-tangible-hope-for-change-in-northern-burma/ (Accessed: 30 July 2024).

Fuhrmann, M. and Horowitz, M.C. (2017) 'Droning On: Explaining the Proliferation of Unmanned Aerial Vehicles', *International Organization*, 71(2), pp. 397–418.

Funaiole, M.P., Jr, J.S.B. and Kurata, K. (2021) 'Tatmadaw Deploys Chinese-Made UAVs'. Available at: https://www.csis.org/analysis/tatmadaw-deploys-chinese-made-uavs (Accessed: 5 April 2024).

Gartzke, E. and Lindsay, J.R. (2015) 'Weaving Tangled Webs: Offense, Defense, and Deception in Cyberspace', *Security Studies*, 24(2), pp. 316–348. Available at: https://doi.org/10.1080/09636412.2015.1038188.

GETTINGER, D. (2019) 'The Drone Databook'. THE CENTER FOR THE STUDY

OF THE DRONE AT BARD COLLEGE.

Gettinger, D. (2020) 'The Drone Databook Updated'. Center for the Study of the Drone at Bard College.

Gill, P. *et al.* (2013) 'Malevolent Creativity in Terrorist Organizations', *The Journal of Creative Behavior*, 47(2), pp. 125–151. Available at: https://doi.org/10.1002/jocb.28.

Gilli, A. and Gilli, M. (2014) 'The Spread of Military Innovations: Adoption Capacity Theory, Tactical Incentives, and the Case of Suicide Terrorism', *Security Studies*, 23(3), p. 513.

Gilli, A. and Gilli, M. (2016) 'The Diffusion of Drone Warfare? Industrial, Organizational, and Infrastructural Constraints', *Security Studies*, 25(1), pp. 50–84. Available at: https://doi.org/10.1080/09636412.2016.1134189.

Gilli, A. and Gilli, M. (2018) 'Emerging Technologies: Unmanned Aerial Vehicles', in H. Meijer and M. Wyss (eds) *The Handbook of European Defence Policies and Armed Forces*. Oxford University Press, p. 0. Available at: https://doi.org/10.1093/oso/9780198790501.003.0044.

Graan, A. (2022) 'What was the project? Thoughts on genre and the project form', *Journal of Cultural Economy*, 15(6), pp. 735–752. Available at: https://doi.org/10.1080/17530350.2022.2087716.

Guzman, T. (2023) 'Myanmar: what Operation 1027 is telling us', *Atlas of wars*, 16 November. Available at: https://www.atlasofwars.com/myanmar-what-operation-1027-is-telling-us/ (Accessed: 30 July 2024).

Hein, Y.M. (2022a) 'One Year On: The Momentum of Myanmar's Armed Rebellion', *Wilson Center Asia Program* [Preprint].

Hein, Y.M. (2022b) *Understanding the People's Defense Forces in Myanmar*. Analysis and Commentary. Washington D.C.: United States Institute for Peace. Available

at: https://www.usip.org/publications/2022/11/understanding-peoples-defense-forces-myanmar (Accessed: 7 December 2023).

Horowitz, M.C. (2017) 'Military Robotics, Autonomous Systems, and the Future of Military Effectiveness', in D. Reiter (ed.) *The Sword's Other Edge: Trade-offs in the Pursuit of Military Effectiveness*. Cambridge: Cambridge University Press, pp. 161–196. Available at: https://doi.org/10.1017/9781108241786.006.

Horowitz, M.C. (2024) 'The Looming Robotics Gap', 13 June. Available at: https://foreignpolicy.com/2014/05/05/the-looming-robotics-gap/ (Accessed: 10 June 2024).

Horowitz, M.C., Kreps, S.E. and Fuhrmann, M. (2016) 'Separating Fact from Fiction in the Debate over Drone Proliferation', *International Security*, 41(2), pp. 7–42. Available at: https://doi.org/doi:10.1162/ISEC_a_00257.

Inside 'Operation 1027', the anti-junta offensive in Myanmar (2023) *Firstpost*. Available at: https://www.firstpost.com/explainers/inside-operation-1027-the-anti-junta-offensive-in-myanmar-13507682.html (Accessed: 30 July 2024).

ISP Myanmar (2023) 'Operation 1027: The Need for a New Political Imagination and a Pragmatic Strategy', *ISP On Point*, 12 December. Available at: https://ispmyanmar.com/op-19/ (Accessed: 30 July 2024).

Jackman, A. (2019) 'Consumer drone evolutions: trends, spaces, temporalities, threats', *Defense & Security Analysis*, 35(4), pp. 362–383. Available at: https://doi.org/10.1080/14751798.2019.1675934.

Kaldor, M. (2012) *New and Old Wars: Organized Violence in a Global Era, Third Edition*. 3rd edn. Stanford: Stanford University Press.

Khalilzada, J. (2022) 'The Proliferation of Combat Drones in Civil and Interstate Conflicts: The Case of Türkiye and Azerbaijan', *Insight Turkey*, 24(3), pp. 89–108.

Kunertova, D. (2023a) 'Drones have boots: Learning from Russia's war in Ukraine',

Contemporary Security Policy, 44(4), pp. 576–591. Available at: https://doi.org/10.1080/13523260.2023.2262792.

Kunertova, D. (2023b) 'The war in Ukraine shows the game-changing effect of drones depends on the game', *Bulletin of the Atomic Scientists*, 79(2), pp. 95–102. Available at: https://doi.org/10.1080/00963402.2023.2178180.

Latt, L.C. *et al.* (2018) 'From Ceasefire to Dialogue: The Problem of "All-Inclusiveness" in Myanmar's Stalled Peace Process', in C. Win et al. (eds) *Myanmar Transformed?: People, Places and Politics*. ISEAS–Yusof Ishak Institute (Lectures, Workshops, and Proceedings of International Conferences), pp. 231–250. Available at: https://www.cambridge.org/core/books/myanmar-transformed/from-ceasefire-to-dialogue-the-problem-of-allinclusiveness-in-myanmars-stalled-peace-process/E12BE92D406AD024285CE49AF7A36940 (Accessed: 5 August 2024).

Lintner, B. and Crispin, S.W. (2021) *Chinese drones a killer eye in the sky in Myanmar*, *Asia Times*. Available at: http://asiatimes.com/2021/05/chinese-drones-a-killer-eye-in-the-sky-in-myanmar/ (Accessed: 5 April 2024).

Lonardo, L. (2021) 'Power to the People. How Open Technological Innovation is Arming Tomorrow's Terrorists: by Audrey Kurth Cronin, Oxford, Oxford University Press, 2020, viii+432 pp., USD $29.95. (hardback). ISBN: 978-0190882143.', *Terrorism and Political Violence*, 33(8), pp. 1820–1821. Available at: https://doi.org/10.1080/09546553.2021.2000223.

Long, A. (2014) 'Dueling Asymmetries: International Terrorism, Insurgency and Drone Warfare in the 21st Century', in *The Future of Warfare in the Twenty First Century*. Emirates Center for Strategic Studies and Research, pp. 13–36. Available at: https://www.cambridge.org/core/books/future-of-warfare-in-the-twenty-first-century/dueling-asymmetries-international-terrorism-insurgency-and-drone-warfare-in-the-21st-century/7FCB2665C6B3607F772BA3FC316797E9 (Accessed: 25 July 2024).

Lyall, J. (2014) 'Process tracing, causal inference, and civil war', in A. Bennett and

J.T. Checkel (eds) *Process Tracing: From Metaphor to Analytic Tool*. Cambridge: Cambridge University Press (Strategies for Social Inquiry), pp. 186–208. Available at: https://doi.org/10.1017/CBO9781139858472.010.

Mahoney, J. (2015a) 'Process Tracing and Historical Explanation', *Security Studies*, 24(2), pp. 200–218. Available at: https://doi.org/10.1080/09636412.2015.1036610.

Mahoney, J. (2015b) 'Process Tracing and Historical Explanation', *Security Studies*, 24(2), pp. 200–218. Available at: https://doi.org/10.1080/09636412.2015.1036610.

'Making Enemies by Mary P. Callahan | Hardcover' (no date) *Cornell University Press*. Available at: https://www.cornellpress.cornell.edu/book/9780801441257/making-enemies/ (Accessed: 5 August 2024).

Malešević, S. (2010a) 'Conclusion', in *The Sociology of War and Violence*. Cambridge: Cambridge University Press, pp. 332–335. Available at: https://doi.org/10.1017/CBO9780511777752.012.

Malešević, S. (2010b) 'Gendering of war', in *The Sociology of War and Violence*. Cambridge: Cambridge University Press, pp. 275–308. Available at: https://doi.org/10.1017/CBO9780511777752.010.

Malešević, S. (ed.) (2010c) 'Introduction: war, violence and the social', in *The Sociology of War and Violence*. Cambridge: Cambridge University Press, pp. 1–14. Available at: https://doi.org/10.1017/CBO9780511777752.001.

Malešević, S. (2010d) 'Nationalism and war', in *The Sociology of War and Violence*. Cambridge: Cambridge University Press, pp. 179–201. Available at: https://doi.org/10.1017/CBO9780511777752.007.

Malešević, S. (2010e) 'New wars?', in *The Sociology of War and Violence*. Cambridge: Cambridge University Press, pp. 311–331. Available at: https://doi.org/10.1017/CBO9780511777752.011.

Malešević, S. (2010f) ‘Organised violence and modernity’, in *The Sociology of War and Violence*. Cambridge: Cambridge University Press, pp. 118–145. Available at: https://doi.org/10.1017/CBO9780511777752.005.

Malešević, S. (2010g) ‘Social stratification, warfare and violence’, in *The Sociology of War and Violence*. Cambridge: Cambridge University Press, pp. 237–274. Available at: https://doi.org/10.1017/CBO9780511777752.009.

Malešević, S. (2010h) ‘The social geographies of warfare’, in *The Sociology of War and Violence*. Cambridge: Cambridge University Press, pp. 146–176. Available at: https://doi.org/10.1017/CBO9780511777752.006.

Malešević, S. (2010i) *The Sociology of War and Violence*. 1st edn. Cambridge University Press. Available at: https://doi.org/10.1017/CBO9780511777752.

Malešević, S. (2010j) ‘War and violence before modernity’, in *The Sociology of War and Violence*. Cambridge: Cambridge University Press, pp. 89–117. Available at: https://doi.org/10.1017/CBO9780511777752.004.

Malešević, S. (2010k) ‘War propaganda and solidarity’, in *The Sociology of War and Violence*. Cambridge: Cambridge University Press, pp. 202–234. Available at: https://doi.org/10.1017/CBO9780511777752.008.

Mansfield, E.D. and Goldstein, A. (eds) (2012) *The Nexus of Economics, Security, and International Relations in East Asia 9780804783347*. Stanford, California: Stanford University Press (Stanford Security Studies). Available at: https://dokumen.pub/the-nexus-of-economics-security-and-international-relations-in-east-asia-9780804783347.html (Accessed: 10 June 2024).

Mathieson, D.S. (2023) *Brotherhood Alliance rewriting Myanmar’s war narrative*, *Asia Times*. Available at: http://asiatimes.com/2023/11/brotherhood-alliance-rewriting-myanmars-war-narrative/ (Accessed: 30 July 2024).

McCarthy, G. and Farrelly, N. (2020) ‘Peri-conflict peace: brokerage, development

and illiberal ceasefires in Myanmar's borderlands', *Conflict, Security & Development*, 20(1), pp. 141–163. Available at: https://doi.org/10.1080/14678802.2019.1705072.

Michaels, M. (2024) *Problems extend beyond battlefield for Myanmar's battered regime*, *The International Institute for Strategic Studies*. Available at: https://myanmar.iiss.org/updates/2024-01 (Accessed: 30 July 2024).

Militarnyi (2024) 'Myanmar Army and Insurgents Turn to FPV Drones', *Militarnyi*, 3 May. Available at: https://mil.in.ua/en/news/myanmar-army-and-insurgents-turn-to-fpv-drones/ (Accessed: 30 July 2024).

Myanmar Junta Chief Says 'Foreign Experts' Helping in Offensive Against Military (2023) *DD NEWS*. Available at: https://ddnews.gov.in/en/myanmar-junta-chief-says-foreign-experts-helping-in-offensive-against-military/ (Accessed: 30 July 2024).

Myint, E.T. (2024) 'Resistance Drones Strike Myanmar Military's SE Command During Junta No. 2's Visit', *The Irrawaddy*, 10 April. Available at: https://www.irrawaddy.com/news/resistance-drones-strike-myanmar-militarys-se-command-during-junta-no-2s-visit.html (Accessed: 30 July 2024).

Myoe, M. (2009) *Building the Tatmadaw*.

Now, M. (2023) *Myanmar military uses drones to attack village in Sagaing's Katha Township*, *Myanmar Now*. Available at: https://myanmar-now.org/en/news/myanmar-military-uses-drones-to-attack-village-in-sagaings-katha-township/ (Accessed: 5 April 2024).

Ong, A. and Steinmüller, H. (2021) 'Communities of care: Public donations, development assistance, and independent philanthropy in the Wa State of Myanmar', *Critique of Anthropology*, 41(1), pp. 65–87. Available at: https://doi.org/10.1177/0308275X20974099.

Oo, M.M. and Sin, K. (2023) *October Offensive by Resistance Forces Exposes Gaps in Myanmar Military*, *FULCRUM*. Available at: https://fulcrum.sg/october-offensive-by-

resistance-forces-exposes-gaps-in-myanmar-military/ (Accessed: 30 July 2024).

"Operation 1027 and the Direction of the Spring Revolution" » Myanmar Peace Monitor (2024). Analysis Paper. Bruma News International, Myanmar Peace Monitor. Available at: https://mmpeacemonitor.org/327510/operation-1027-and-the-direction-of-the-spring-revolution/ (Accessed: 30 July 2024).

Parkinson, S.E. (2023) *Beyond the Lines: Social Networks and Palestinian Militant Organizations in Wartime Lebanon*. Ithaca: Cornell University Press. Available at: https://muse.jhu.edu/pub/255/oa_monograph/book/100079 (Accessed: 30 November 2023).

Pouliot, V. (2014) 'Practice tracing', in A. Bennett and J.T. Checkel (eds) *Process Tracing: From Metaphor to Analytic Tool*. Cambridge: Cambridge University Press (Strategies for Social Inquiry), pp. 237–259. Available at: https://doi.org/10.1017/CBO9781139858472.013.

Ratner, S.B., Ben FitzGerald, Ely (2024) 'The Drone War Comes to Asia', 13 June. Available at: https://foreignpolicy.com/2013/09/17/the-drone-war-comes-to-asia/ (Accessed: 10 June 2024).

Recchia, S. (2015) 'Soldiers, Civilians, and Multilateral Humanitarian Intervention', *Security Studies*, 24(2), pp. 251–283. Available at: https://doi.org/10.1080/09636412.2015.1036626.

Reh, S. (2024) *Myanmar military deploys 'kamikaze drones' in southern Shan State*, *Myanmar Now*. Available at: https://myanmar-now.org/en/news/myanmar-military-deploys-kamikaze-drones-in-southern-shan-state/ (Accessed: 5 April 2024).

Reuters (2023) 'Insight: Rebel fire and China's ire: Inside Myanmar's anti-junta offensive', *Reuters*, 20 December. Available at: https://www.reuters.com/world/asia-pacific/rebel-fire-chinas-ire-inside-myanmars-anti-junta-offensive-2023-12-15/ (Accessed: 30 July 2024).

RFA Burmese (2023) *2 years after coup, drones turning the tide for Myanmar's*

armed resistance, *Radio Free Asia*. Available at: https://www.rfa.org/english/news/myanmar/drones-01252023173803.html (Accessed: 7 December 2023).

Rogers, J. and Kunertova, D. (2022) *The Vulnerabilities of the Drone Age: Established Threats and Emerging Issues out to 2035*, *The Vulnerabilities of the Drone Age*. Report.

Rogers, J.P. (ed.) (2024) *De Gruyter Handbook of Drone Warfare* (4 vol). De Gruyter (De Gruyter Contemporary Social Sciences Handbooks, 4). Available at: https://www.degruyter.com/document/isbn/9783110742039/html?lang=en (Accessed: 24 July 2024).

Ronfeldt, D. and Arquilla, J. (2000) 'Swarming and Future of Conflict'. Rand National Defense Research Institute.

Rossiter, A. (2018) 'Drone usage by militant groups: exploring variation in adoption', *Defense & Security Analysis*, 34(2), pp. 113–126. Available at: https://doi.org/10.1080/14751798.2018.1478183.

Ruback, T.J. (2010) '"Let Me Tell the Story Straight On": Middlemarch, Process-Tracing Methods and the Politics of Narrative', *The British Journal of Politics and International Relations*, 12(4), pp. 477–497. Available at: https://doi.org/10.1111/j.1467-856X.2010.00425.x.

Sayler, K. (2015) *A WORLD OF PROLIFERATED DRONES: A Technology Primer*. Center for a New American Security.

Schulzke, M. (2019) 'Drone Proliferation and the Challenge of Regulating Dual-Use Technologies', *International Studies Review*, 21(3), pp. 497–517. Available at: https://doi.org/10.1093/isr/viy047.

Sin, K. (2023) *Resistance Forces in Myanmar: Changing the State of Play with Weaponised Drones*, *FULCRUM*. Available at: https://fulcrum.sg/resistance-forces-in-

myanmar-changing-the-state-of-play-with-weaponised-drones/ (Accessed: 30 July 2024).

Sin, K. (2024) *Commentary: Drones are changing the state of play for Myanmar resistance forces*, *CNA*. Available at: https://www.channelnewsasia.com/commentary/myanmar-military-coup-drones-air-strike-tatmadaw-resistance-pdf-nug-3269191 (Accessed: 30 July 2024).

Swed, O. (2020) 'Off the Shelf: The Violent Nonstate Actor Drone Threat', *Air & Space Power Journal* [Preprint]. Available at: https://www.academia.edu/44446133/Off_the_Shelf_The_Violent_Nonstate_Actor_Drone_Threat (Accessed: 4 April 2024).

Tannenwald, N. (2015) 'Process Tracing and Security Studies', *Security Studies*, 24(2), pp. 219–227. Available at: https://doi.org/10.1080/09636412.2015.1036614.

The Democratization of Airpower: The Insurgent and the Drone (2016). Available at: https://warontherocks.com/2016/10/the-democratization-of-airpower-the-insurgent-and-the-drone/ (Accessed: 24 July 2024).

Veilleux-Lepage, Y. (2024) 'Tower 22 Innovations in Drone Attacks by Non State Actors International Centre for Counter Terrorism ICCT'. Available at: https://www.academia.edu/115590579/Tower_22_Innovations_in_Drone_Attacks_by_Non_State_Actors_International_Centre_for_Counter_Terrorism_ICCT (Accessed: 4 April 2024).

Waldner, D. (2014) 'What makes process tracing good?: Causal mechanisms, causal inference, and the completeness standard in comparative politics', in A. Bennett and J.T. Checkel (eds) *Process Tracing: From Metaphor to Analytic Tool*. Cambridge: Cambridge University Press (Strategies for Social Inquiry), pp. 126–152. Available at: https://doi.org/10.1017/CBO9781139858472.008.

Waldner, D. (2015) 'Process Tracing and Qualitative Causal Inference', *Security Studies*, 24(2), pp. 239–250. Available at: https://doi.org/10.1080/09636412.2015.1036624.

Wallace, D.A. and Reeves, S. (2013) 'Non-State Armed Groups and Technology: The Humanitarian Tragedy at Our Doorstep?', *University of Miami National Security & Armed Conflict Law Review*, 3, pp. 26–45.

Walton, S.A. (2019) 'Technological Determinism(s) and the Study of War'. Available at: https://doi.org/10.1163/22134603-00701003.

Wansai, S. (2024) *1027 OPERATION POLITICAL FALLOUT: Inter-ethnic conflict and people's sufferings in northern Shan State*, *Shan Herald Agency for News*. Available at: https://english.shannews.org/archives/27080 (Accessed: 30 July 2024).

West, G. (2015) 'Drone On', *Foreign Affairs*, 1 May. Available at: https://www.foreignaffairs.com/drone (Accessed: 28 July 2024).

Wings over Mandalay: Myanmar's junta deploy Chinese-made CH-3A tactical UAVs to observe protest movements (2021) *Janes*. Available at: https://www.janes.com/osint-insights/defence-news/latest analysis/myanmar-junta-deploy-chinese-made-ch-3a-tactical-uavs-to-observe-protest-movements (Accessed: 25 July 2024).

Wodak, R. (2007) 'Discourses in European Union organizations: Aspects of access, participation, and exclusion', *Text & Talk - TEXT TALK*, 27, pp. 655–680. Available at: https://doi.org/10.1515/TEXT.2007.030.

Završnik, A. (2016) 'Chapter 1: Introduction: Situating Drones in Surveillance Societies', in A. Završnik (ed.) *Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance*. Cham: Springer International Publishing, pp. 1–18. Available at: https://doi.org/10.1007/978-3-319-23760-2.

အေးချမ်းဆု (2023a) မြန်မာပြည်ရှိ လက်နက်ကိုင်တော်လှန်ရေး အင်အားစုများ (အပိုင်း ၁), ဧရာဝတီ. Available at: https://burma.irrawaddy.com/article/2023/10/11/375308.html (Accessed: 6 August 2024).

အေးချမ်းဆု (2023b) မြန်မာပြည်ရှိ လက်နက်ကိုင်တော်လှန်ရေး အင်အားစုများ (အပိုင်း ၂), ဧရာဝတီ. Available at: https://burma.irrawaddy.com/article/2023/10/13/375375.html (Accessed: 6 August 2024)

Appendix 1

University of Glasgow
College of Social Sciences

Ethics Committee for Non-Clinical Research Involving Human Subjects

Notification of Ethics Application Outcome – UG and PGT Student Applications

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Application Details

Undergraduate Student Research Ethics Application ☐ Postgraduate Student Research Ethics Application ☒

Application Number: PGT/SPS/2024/209/IMSISS

Applicant's Name: **Nyein Nyein Thant Aung**

Project Title: Adaptation and Innovation: Commercial Drones in Myanmar's Emerging Armed Conflict Dynamics

Application Status: Fully Approved

Date of Review: 02/07/2024

Start Date of Approval 02/07/2024 End Date of Approval 29/09/2024

NB: Only if the applicant has been given approval can they proceed with their data collection with effect from the date of approval.

Recommendations (where changes are required)

Where changes are required by reviewers all applicants must respond in the relevant boxes to the recommendations of the Committee and provide this as the Resubmission Document to explain the changes you have made to the application as well as amending the documents. Changes to the application form or supporting documents should be highlighted either in block highlight or in red coloured text to assist the reviewers.

All resubmitted application documents should then be provided.

Approval Subject to Amendments means that the applicant can proceed with data collection with effect from the date of approval, but amendments must be fulfilled.

Amendments Subject to SEF should be submitted to ethics administrator.

If your application is rejected a new application must be submitted to the ethics administrator. Where recommendations are provided, they should be responded to and this document provided as part of the new application. A new reference number will be generated.

REVIEWER MAJOR RECOMMENDATIONS	APPLICANT RESPONSE

REVIEWER MINOR RECOMMENDATIONS	APPLICANT RESPONSE

ADDITIONAL REVIEWER COMMENTS	APPLICANT RESPONSE
Many thanks for replying to numerous comments so clearly. This application has now been fully approved. Best wishes with your research.	