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BRINGING THE REPUBLIC OF MOLDOVA TO THE ATTENTION OF WESTERN POLICYMAKERS. TRANSNISTRIA AND THE SEPARATIST CAUSE

Marina STANESCU

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For the Republic of Moldova, often ranked as the poorest country in Europe, the last two years were both the worst and best years. Against the backdrop of Russia's brutal and inhumane war against Ukraine, the Republic of Moldova faces challenges at numerous levels, ranging from a fragile economy to having foreign military forces illegally stationed on its territory. Furthermore, having not one, but two separatist regions on its land, both controlled, de facto, by the Russian Federation, adds considerable pressure on the current pro-European government. The Russian Federation employs a wide range of hybrid instruments to intervene in the Republic of Moldova's internal affairs. Having witnessed Russia's aggressive actions in Ukraine, but not only, the international community is now paying considerably more attention to the Republic of Moldova. One self-explanatory reason would be that the Republic of Moldova hosted the European Political Community Summit, the largest and most important international event in its history. Consequently, the goal of this article is to highlight that the Republic of Moldova can only secure prospects for development, stability and democracy through broader integration into European community.

Key words: *Republic of Moldova, Transnistria, Russian interference, EU, NATO, soft power, peaceful settlement.*

1. PRELIMINARY CONSIDERATIONS

Against the backdrop of the Russian brutal war against Ukraine, the Republic of Moldova's internal situation was greatly disturbed. Being already in a difficult economic situation, Moldova, a country with a population of 2.6 million people, took more than one hundred thousand Ukrainian refugees [1] almost instantly. The influx of refugees has resulted in additional financial costs, consuming resources from other budgetary priorities. As a result, inflation was rampant and the economy was worn out, its resources being close to collapsing. Supported

by external donors, especially by the European Union, Moldova managed to liberate itself from Russian gas dependence. However, being completely dependent on one source has its costs, and diversifying overnight soared the utility bills. Moreover, Moldova was dependent on mainly two electricity providers, Ukraine as the main source and Transnistria as a secondary one. The war damaged the main power line and provoked major power blackouts all over the territory. Also, Transnistria attempted to blackmail Chisinau to provide free-of-charge gas in return for low-priced electricity. Furthermore, leveraging the military element generated serious security concerns, even more than before the war. This assessment is well reflected in Moldovan Strategic Documents (National Defence Strategy [2] and National Security Strategy [3]) the Transnistrian frozen conflict represents the main threat to Moldova's security, sovereignty, and stability.

Broadly, the Russian invasion of Ukraine starkly exposed the vulnerabilities of the Moldovan socio-economic architecture, which was already weakened by the pandemic and energy crisis. Starting with October 2021, the newly appointed Moldovan government had to face simultaneous crises on many levels and domains, being energetic, economic, social, and military. Moldova is currently one of the most affected countries by the war in Ukraine, not only because of its geographical proximity but also because of its inherent vulnerabilities as a small and conceptual divided country, with close linkages to both Ukraine and Russia.

However paradoxical it may seem the internal situation took on a new spin after the war and all governmental efforts to redress the economy were bolstered by the European Council's decision to grant European Union Candidate country status to Moldova and subsequent financial support.

2. BRIEF HISTORIC VIEW OF THE TRANSNISTRIAN CONFLICT AND ITS IMPACT ON MOLDOVAN SOCIETY

Following the dismemberment of the Soviet Union, around 170 conflict zones broke out in the perimeter of its former space, 30 of which took an active form, and in 10 cases armed conflicts took place, most of them of a separatist nature. Secessionism, either fuelled by geopolitical, economic, and security interests, or aiming at the restoration of the Soviet state, is one of the perpetual problems faced by the Republic of Moldova (De Waal, 2023).

The Transnistria separation occurred following a violent conflict, which erupted based on so-called concerns about Moldovan nationalism and possible unification with Romania. Against the backdrop of Moldovan Socialist Soviet Republic (SSR) demanding political and social reforms, as well as the recognition of the Moldovan language as the official language of the state, the separatist leaders from Tiraspol generated a series of violent actions. Supported by Russia, on September 2, 1990, the Dniester Moldavian Socialist Soviet Republic was proclaimed and the process of consolidating the enclave began. Then the Provisional Supreme Soviet of the self-proclaimed republic led by Igor Smirnov, was elected. In 1990, 3,000 officers and over 12,000 conscripts and contract military were stationed on the left side of the Dniester, constituting the 14th Army of the USSR armed forces, equipped with an enormous amount of military equipment and ammunition.

Clashes between the government forces of the Republic of Moldova and those of the Transnistrian Republic began at the end of 1990. Tensions increased as soon as the Republic of Moldova declared its independence in August 1991 and degenerated into an armed conflict in July 1992. On the side of the separatists, Russia became involved militarily and politically through the 14th Army, stationed nearby. Over 1,000 people were killed and 4,500 were injured (Klimenko, 2018, p. 11-12). The Moldovan-Transnistrian conflict ended on June 21, 1992, following the agreement signed between the Russian President, Boris Yeltsin, and the Moldovan one, Mircea Snegur.

The Moldovan-Transnistrian conflict, like many others in the ex-Soviet space, can have its cause in the Soviet legacy - in particular, "political nationality, the illegal division of resources within the Moldavian SSR, but also the consequences of perestroika and glasnost", all of them part of the policy promoted by the last president of the USSR, Mikhail Gorbachev (Klimenko, 2018, p.11-12).

The international community does not recognize Transnistria's status as a self-proclaimed state, nor the de facto leadership in Tiraspol, which continues to aggressively advocate its right to independence, exerting constant pressure on the government in Chisinau. The main factor fuelling the tensions between the parties remains the Russian Federation, which supports the region economically, politically, and militarily.

At the same time, to this day, Russia maintains approximately 1,500 soldiers illegally deployed in Transnistria, divided into

"peacekeepers" and the Operative Group of Russian Troops (OGRT), who guard the ammunition depot at Cobasna, despite Moldovan authorities' repeated demands to withdraw them. However, since its independence, Moldova has had different opinion-oriented leadership and some of those regarded the presence of foreign troops as useful in maintaining peace in the region. These approaches varied and alternated throughout Moldova's existence as an independent state. Jeff Chinn stated that the Republic of Moldova is one of the first ex-Soviet republics that claimed new relations with Moscow, showed intransigence during the consolidation of independence, and carried out reforms comparable to those applied in the Baltic States, but not without showing ambiguity and hypocrisy in promoting its policies (Chinn, 1997, p. 43-51).

The conflict became a frozen one and the Russian-led operation turned into a permanent positioning of Russian troops on the front line. The peace negotiation process was taking place in the "5+2" format: Transnistria and Moldova, and the Organization for Security and Co-operation in Europe (OSCE), Russia, and Ukraine as mediators, plus the USA and the European Union (EU) as observers. However, after the Russian brutal and unprovoked war against Ukraine, even the settlement

negotiation was frozen for obvious reasons.

The Transnistrian conflict remains one of the most representative frozen conflicts in the ex-Soviet space. Its evolution always depended on external factors such as Chisinau's leadership orientation (pro-East or pro-West), Ukraine, or international organizations' involvement.

From a political perspective, the process of settling the Transnistrian conflict, in a broad sense, represented the resignation of the leaders in Chisinau to the support given by Russia to the Tiraspol regime. The leaders from Chisinau were forced, in the absence of consistent support from the international community, to accept the demands of Russia and Tiraspol to sign official documents together with the leaders of the unrecognized Transnistria regime. Mircea Snegur signed, in 1994, a Joint Declaration with the leader of the separatist regime, Igor Smirnov, and the Agreement between the Republic of Moldova and the Russian Federation regarding the legal status, manner, and terms of withdrawal of the military formations of the Russian Federation temporarily stationed on the territory of the Republic of Moldova (Medar & Savu, 2005). Snegur's signing of the Joint Declaration was criticized by the political opposition who considered

the declaration to mark yet another stage in the process of enslaving the country to Russian interests. President, Petru Lucinschi, is the one who approved, in 1997, the conclusion of the Memorandum on the principles of the normalization of Moldovan-Transnistrian relations, but there were no concrete mentions regarding the resolution of the conflict, nor whether the conflict should be resolved by maintaining the territorial integrity of the Republic of Moldova (Racheru, 2020).

Diplomatically, there have been several attempts to resolve the conflict peacefully. After, more than a decade of independence, a period often characterized by a servile policy vis-à-vis Russia, in 2003, President Voronin refused to sign the "so-called Kozak plan, for the settlement of the Transnistrian conflict, by which the separatist region was asked to meet multiple conditions separate from the territory of the Republic of Moldova and declare its independence" (Medar & Savu, 2005). That signals the Republic of Moldova' shift towards the West..

Dmitri Kozak, the Russian Deputy Prime Minister in the Medvedev Government and special representative of the Russian President, Vladimir Putin, in relations with the Republic of Moldova, presented the so-called "Kozak Memorandum" which generated strong reactions both in Chisinau and in other European capitals. The "Kozak Memorandum" was a proposal aimed at a definitive settlement of the conflict between the Republic of Moldova and the separatist regime in Transnistria, by establishing an asymmetric federal Moldovan state. It also provided for the stationing of Russian troops on the territory of Moldova until 2023. At the same time, the memorandum proposed the creation of a bicameral parliament whose composition was disproportionate in relation to the distribution of the population on the territories. The control of the upper chamber was to be exercised by Transnistria and Gagauzia. As expected, the plan sparked widespread social movements, with tens of thousands of people taking to the streets in the fall of 2003 to oppose its implementation. The national interests and strategic objectives of the state would have been compromised if this plan were accepted [4].

President Vladimir Voronin, in an attempt to normalize relations with Moscow, argued the rejection of the Memorandum on the grounds of incompatibility with the Constitution of the Republic of Moldova, which defines the Republic of Moldova as a neutral state, on whose territory foreign troops cannot be allowed to enter. However, that did not convince the Kremlin, which maintained its assertiveness through discriminatory policies and direct threats [5].

Dimitri Kozak returned to the attention of the media from Chisinau in July 2018, when Vladimir Putin appointed him as his special representative for the development of commercial and economic relations with the Republic of Moldova, thus replacing Dmitri Rogozin, who had been declared undesirable in the territory Republic of Moldova. However, Kozak was declared persona non grata in the European Union's space, having been placed on the sanctions list in April 2014, following Russia's illegal annexation of Crimea and the outbreak of the conflict in eastern Ukraine.

In 2006, a referendum, not recognized by the Republic of Moldova, reaffirmed the desire for independence of the territory and union with Russia, and Vadim Krasnoselsky became president of the region in December 2016, being re-elected in the elections of December 2021 [6].

Some researchers believe that Transnistria "may become the new Crimea for Russia if it recognizes the independence of the separatist territory" (Klimenko, 2018, p.15). The strategic importance of Transnistria changed after the annexation of Crimea. But, at the moment, Russia's position no longer allows it to initiate a new conflict. From a military perspective, it must be emphasized that on the territory of the separatist region, there are not only Russian troops stationed illegally but also an ammunition depot, in Cobasna, near

the border with Ukraine and 120 km from Chisinau. The warehouse is the largest military warehouse in Eastern Europe, but in the last decade, there have been no control/assessment visits by any officials from Chisinau or any other relevant international organization [7]. It is estimated that around 20 thousand tons of ammunition are kept in the warehouse, de facto controlled by Russia.The central authorities of the Republic of Moldova have no access to that.

Moscow influenced politics in Chisinau by controlling corrupted people in key positions, undermining national interests, independence, and state unity. Over time, Chisinau showed some timid initiatives to involve the UN in the process of resolving the conflict in Transnistria, but the attempt was unsuccessful resulting in only two visits of UN representatives to the Republic of Moldova during the conflict to hold talks with the parties involved. In addition, the Secretary General of the United Nations sent a letter condemning Russia's actions in Transnistria, which was received with the same indifference as other international efforts to resolve the Transnistrian conflict [8].

The Moldova–Transnistria conflict remains one of the regional legacies of the end of the Cold War. It has been a frozen conflict for the past three decades and the very little information available in the public space about it created the perception of the region as

Europe's 'black hole' (Baynov, 2009, p 143). The internal situation in Transnistria remains strictly controlled: the press, many television stations are mainly owned either directly by the regional government or by Kremlin. The region has its currency, constitution, parliament, flag, and anthem. The internal situation is characterized by corruption, organized crime, and smuggling, especially of weapons, but not only.

The Tiraspol administration has always been an instrument of pressure on the sovereignty and integrity of the Republic of Moldova. The Russian Federation controlled the evolution and development of the Republic of Moldova through various instruments, but the Transnistrian conflict represents one of the most important pressure points, being a constant factor of instability and military threat to the Moldovan state.

3. RUSSIAN WAR AGAINST UKRAINE – IMPACT ON MOLDOVA

Today's security context, in which the Republic of Moldova finds itself, proves that the security sector must be approached distinctly from that of the past. The increasing global uncertainty, more sophisticated and disruptive cyber and hybrid threats, and military confrontation in the neighboring country –Ukraine- have a direct impact on Moldova's security.

In this fluid environment, the Moldovan leadership acknowledged the importance of adopting a more integrated and better-coordinated approach to resilience. With support from NATO and European Union, Moldova consolidated its state institutions and took concrete measures to counter Russian energetic coercion and malign interference in Moldovan society.

The war in Ukraine determined a reanalysis of the priorities and strategic objectives of the Republic of Moldova. As it was all too natural, in the face of a direct military threat and increased political pressure, backed by massive economic blackmail, the Moldovan government refocused its attention on the defense and security sphere. Against the backdrop of powerful Russian propaganda and disinformation surrounding the neutrality concept, enshrined in the Moldovan Constitution in 1994, defense (the military in particular) was constantly underfunded by all previous governments. The allocation of 0.38% of the GDP for defense is insufficient to sustain any procurement or endowment process. In the context of the war, for the year 2023, the allocations were considerably increased to 0.55% of GDP [9].

Moreover, President Maia Sandu, admitting the importance of having a credible and robust strategic communication architecture with an overarching approach decided the creation of the National Centre for

Information Protection and Counter-Propaganda – PATRIOT. The draft law on the establishment of the National Centre initiated by President Maia Sandu, has been submitted for public consultations allowing thus the people to have a say in the concept of this initiative

In the context of the war in the immediate vicinity of the Republic of Moldova, relations with the European Union have gained particular importance even in the military sphere, which was not a traditional area of cooperation with the EU. The entire defense and security sector is going through an extensive process of reform and modernization, currently massively supported by the EU through the European Peace Facility which allocates 40 million euros for defense expenditure. These funds are being allocated on a yearly base, first tranche consisted of 7 million in 2021, 40 million for 2022, and 40 million for 2023, as well. The funds provided through the framework of the European Peace Facility are destined for the acquisition of air surveillance equipment, mobility and transport, logistics, command and control, and cyber defense equipment [10].

In addition, the Council of the European Union decided to double the amount of macroeconomic assistance to Moldova - up to 295 million Euros [11]. Nonetheless, it should be emphasized that the political and financial support given by the European Union to the Republic of Moldova is unprecedented. The

situation itself is completely atypical and almost unthinkable before the outbreak of the war in Ukraine.

From an economic angle, Moldova started experiencing the effects of the energy blackmail imposed by the Russian Federation in October 2021, when Gazprom drastically reduced the volume of gas delivered to Moldova. Since that time, gas prices have increased significantly in the Republic of Moldova, both due to the latest developments in the regional energy markets and against the background of the war in Ukraine (the purchase price of gas increased from 265 US dollars/1,000 m3 in 2021 to US$1,193/1,000 m3 in April 2022). With the financial support provided by the EU and other external partners, the state bought gas from the European zone to ensure the required volume. Later, this blackmail is overcome and at the same time, legislative changes are made that allow to avoid situations of this kind in the future, by storing some reserve quantities on the territory of Romania. The change unlocks more purchasing options, which will strengthen the security of the gas supply and could help control costs for consumers [12].

There is no doubt that Moldova could acquire the entire amount of gas needed from alternative sources thus overpassing the Russian deadlock, with external support from the European partners. However, there are voices enquiring about the fate of the Transnistrian region economy in such a case. What will happen if the archaic

Kuchurgan plant will not receive its free Russian gas? The local self-governing authorities do not have the means to support the 5000 people living on the territory, many of whom are pensioners. This concern is high on Moldovan leadership's agenda, and it appears that a soft power approach is used in solving this conflict.

To reinforce the soft balancing Moldovan approach, the EU high representative for foreign affairs and security policy, Josep Borrell, present at the inauguration of the European Union Partnership Mission headquarters said: "*The Republic of Moldova independently decides what happens with the Transnistrian region. Cyprus became a member of the European Union having a territorial issue. Moldova can also do this*". The EU civilian mission in the Republic of Moldova (EUPM Moldova) was initiated at the request of the Republic of Moldova to strengthen its resilience, security, stability, and economy and to help it on its way to accession.

Nicu Popescu, the Deputy Prime Minister and Minister of Foreign Affairs, on the same occasion, stated "*It is a very important step for strengthening our capabilities and strengthening our state, for strengthening our resilience, which will allow us to continue to ensure stability, peace and calm. (...) We know we are not alone. We benefit from the support of our friends*" [13].

Indeed, Moldova is not alone, and the European Political Community Summit, a pan-European governmental forum serving as a platform that brings together European leaders to discuss and identify solutions for Europe's most pressing issues, has been hosted on 1-2 June 2023 by the Republic of Moldova, proved the unity and solidarity of the European space. Maia Sandu and Vladimir Zelenski had a common press statement on this occasion. President Zelenski delivered a message from the Ukrainian people: "We support Moldova, we are ready to walk historically together, shoulder to shoulder. We thank the Moldovans for hosting all our people, all the refugees from the large-scale war, we will not forget that" [14].

4. SOFT BALANCING APPROACH OF NATO AND EU

The pretext of neutrality has been used, ever since the adoption of this statute in 1994, as a shield against any threat, a policy that has proven ineffective in the current context. Recently a redefinition of the concept of neutrality in the public space is noticeable. In this sense, the Minister of Defense, Anatolie Nosatîi mentioned in an interview that "the status of neutrality has left us alone in the face of challenges, with a defense system that is not

relevant in the present context". According to the minister, discussions regarding the revision of the neutrality status are the prerogative of politicians, and a possible decision regarding joining a military alliance must be made after an extensive consultation process with citizens. The Minister of Defense also mentioned that the Republic of Moldova is not ready for joining NATO, and the controversies created around this topic are part of the hybrid war [15] .

President Maia Sandu recently stated that "neutrality does not mean we shouldn't invest in the defense of the country". When asked about a potential NATO accession, the president said in an interview with the publication Politico that her country is still analyzing the next step and that a constitutional amendment would be needed to do so. "We're having a serious discussion these days ... about our ability to defend ourselves, whether we can do it alone or whether we should be part of a larger alliance." Additionally, the president noted that "if we're reaching, at some point, the conclusion, as a nation, that we need to change neutrality, that should happen through a democratic process" [16]. Analyzing the public statements of the two most important people in the state, from a political-military perspective, we understand that neutrality is a

concept that is undergoing a process of reanalysis, at least from a conceptual point of view. In this context, it should be mentioned that the Republic of Moldova is a long-standing and valuable partner of the Nord Atlantic Alliance: bilateral cooperation began in 1994 when Moldova joined the Partnership for Peace program and has never been interrupted, regardless of the political affiliation or orientation of the leadership from Chisinau.

The cornerstone of the cooperation was the 2022 Madrid Summit when the Allies agreed to step up political and practical support for partners facing pressure and threats from Russia. In practice, this means that Moldova benefits from a tailored package of support measures to help state institutions strengthen their capacity to defend themselves, national resilience, and civilian preparedness [17].

Moldova is also a valuable contributor to international security through its participation in peacekeeping missions. Since 2014 Moldova is participating in a NATO-led mission to Kosovo – KFOR. It is very important for Moldova to continue to contribute to a stable and peaceful Europe, according to the Foreign Minister Popescu' comment on the recent clashes in Kosovo, where Moldovan military personnel were also injured [18].

From a political-military perspective, cooperation with NATO is beneficial in achieving the national strategic objectives, the assistance provided being mainly intended to ensure national security. Cooperation relations are carried out in accordance with the fields stipulated in the framework document that regulates bilateral cooperation between the parties - the Individual Partnership Action Plan (IPAP) [19]. However, it should be noted that at this moment it is premature to discuss membership, this being in contradiction with the constitutional provisions of neutrality. In addition, according to opinion polls, NATO is not a trusted organization, on the contrary, it is considered a strictly military Alliance with a destabilizing potential. Furthermore, only 10% of the population believes that NATO can ensure their security and 26% are in favor of a possible future accession [20].

Both the EU and NATO have greatly expanded efforts to support the Moldovan authorities to address the frozen conflict in Transnistria in the last few years. These efforts fall into the category of 'soft balancing' actions that imply the application of non-military methods, against Russian influence in the conflict and in Moldova more generally. One can argue that recent developments in Ukraine demonstrate the limitations of this strategy. Precisely because the application of this soft power has done little to change the incentives for separatist leaders or their Russian backers. However, the EU and NATO, and other actors contributed greatly to augmenting Moldova's ability to face the challenges posed by the conflict (Kennedy, 2016).

The concept of soft balancing was developed as a method to explain why secondary powers did not engage in either internal or external balancing against the hegemony of one state. While there have been several proposed definitions of soft balancing, most of them comprise at least two key aspects. First, soft balancing actions place a constraint on the field of action of another actor. Second, they accomplish this using tactics that are more 'tacit' or non-confrontational. This is in contrast with more traditional views of balancing, which usually include an explicit military aspect (Schweller, 2004, p. 159-201) [21].

The results of this strategy adopted by both the EU and NATO have been mixed. There is undoubtedly a quantifiable positive impact of these soft-balancing actions, especially when it comes to stimulating reforms and democratic values. NATO and EU soft power methods have changed Moldova's foreign relations substantially by sustaining the transformation of the country from within. Through various capacity development projects targeting both state institutions and civil society organizations, NATO and the EU

stimulated the development of national resilience and European identity. While enabling partnerships and boosting practical cooperation in a fundamentally changed security environment the soft power methods proved their power to support free democratic nations around the world to be able to make their own sovereign choice.

Even if there has been little indication that the political calculations of the leadership of Transnistria have changed over the years, international support has profoundly changed the economic landscape in the region, making it less dependent on Russia's market and more compatible with European standards. The economic exchange and trade with the European area are on an ascending trend. For example, over 67% of goods exported from Transnistria reached the European Union in 2022, with a significant increase of approximately 10% in contrast to 2021 [22].

Assistance in training and mentoring the Moldovan institutions to cope with the challenges imposed by the breakaway region has helped the Moldovans to distance themselves from Russian dominance and interference. By doing so Moldova became relevant for Western policymakers who invested further economically and politically in Moldova.

5. CONCLUSIONS

The war in Ukraine has saved Moldova, at great costs and that should not be taken for granted. The war threat receded as the Russians could not take the Odessa region and connect the Russian forces with the ones in Transnistria. The cornerstone of the separatist cause is the Russian Federation, which serves as the region's patron. As long as Transnistria's future remains unclear, tensions will continue. Moldova's prime minister has prioritized demilitarising the area, and the foreign minister has said it will continue to seek a peaceful solution. But Russian President Vladimir Putin has pointedly revoked a 2012 decree committing Russia to find a solution for Transnistria based on respect for Moldova's sovereignty and territorial integrity.

While Russia maintains its hard power influence in the region, in contravention of its obligations under the 1999 OSCE Istanbul Summit Decision, the EU and NATO are promoting capacity building, inter-institutional cooperation, economic and social well-being of people, and diplomatic solutions for settling the conflict. The decision of the EU and NATO to support Moldova's soft balancing efforts, rather than taking a more hard power approach, proved to be expedient for all parties involved as Chișinău —alongside Kyiv —received something precious it might have

waited decades for in less extreme circumstances: EU candidate status.

Moldova's pro-European president, Maia Sandu, and her government want to build on that and open EU accession talks by the end of 2023. It is irrefutable that today Moldova's political autonomy vis-à-vis Russia is considerably higher than it was a few years ago. The European Political Community Summit held in Moldova, only 20 kilometres away from the ongoing war, on 1-2 June 2023, certified the European community's support for Moldova, while sending a powerful message of unity and peace to the Moscow regime.

ENDNOTES

[1] Between February 24, 2022 and February 22, 2023, 937,568 citizens of Ukraine entered the Republic of Moldova - https://www.border.gov.md/index.php/circa-un-milion-de-cetateni-ucraineni-au-intrat-r-moldova-de-la-inceputul-razboiului-din-ucraina, accessed 29 May

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CAPABILITY-BASED PLANNING AND PROGRAM BUDGETING APPROACHES: ENHANCING SUSTAINABILITY AND UTILITY OF DEFENSE FORCES

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Capability-Based Planning (CBP) and Program Budgeting (PB) are powerful tools that contribute to the sustainability and utility of defense forces. CBP prioritizes and allocates resources based on desired capabilities to achieve strategic objectives, ensuring adaptability and responsiveness to potential threats. PB allocates resources based on specific programs, focusing on results and aligning funding with outputs and outcomes. This article explores how the simultaneous application of CBP and PB can enhance the efficiency and effectiveness of defense resource management. CBP enables the development of a comprehensive force structure plan, while PB facilitates informed resource allocation and optimization over a medium-term period. The alignment between required capabilities, produced outputs, and desired outcomes outlined by national defense objectives is crucial. By adopting these approaches, defense organizations can strategically allocate resources, prioritize high-priority programs, and produce desired military capabilities. This results in improved transparency, accountability, and performance measurement, ultimately enhancing the sustainability and utility of defense forces. The adoption of CBP and PB fosters a more effective and efficient defense resource management process, enabling defense forces to effectively respond to evolving security challenges.

Key words: *Capability-Based Planning (CBP), Program Budgeting (PB), sustainability, utility, Defense Forces.*

1. INTRODUCTION

Capability-Based Planning (CBP) is an approach used in defense planning to prioritize and allocate resources based on the desired capabilities required to achieve strategic objectives. It aims to ensure that military forces are equipped with the right mix of capabilities to effectively respond to a wide range of potential threats and challenges. By adopting a CBP approach, military organizations aim to be more flexible, adaptable, and responsive to changing

circumstances. CBP is oriented on developing future force and focused on elaboration of a force development plan. It informs senior defense decision-makers "on how to organize, train, equip, resource, and provide capability to force elements in support of policy objectives – within allocated resource limits – to carry out armed forces activities and operations" (Taliaffero et al., 2019).

Program Budgeting (PB) is an approach to budgeting used in the defense sector that focuses on allocating resources based on specific programs rather than traditional line-item budgets. It aims to align funding with outputs (capabilities) and outcomes (strategic objectives), enabling better transparency, accountability, and performance measurement. Properly implemented, PB implies planning, programming and budgeting processes, and provides clear linkage between defense policy, strategy, capability planning, and budget planning and execution. By adopting PB, defense organizations can make more informed decisions regarding resource allocation, prioritize high-priority programs (projects), and optimize the utilization of available resources over a four- to six-year period (Taliaffero et al., 2017). It enables a more strategic and results-oriented approach to budgeting, ensuring that resources are aligned with defense priorities and produce the desired military capabilities.

This article provides an overview of two key concepts in defense planning and resource management: Capability-Based Planning (CBP) and Program Budgeting (PB). The adoption of these approaches is crucial for effective resource allocation, strategic planning, and the achievement of desired defense outputs and outcomes. These approaches facilitate the alignment of capabilities with national defense objectives, resulting in more sustainable, efficient, and effective defense forces capable of addressing evolving security challenges. When applied simultaneously, both approaches serve as effective tools to ensure the sustainability and utility of the Defense Forces.

2. CONCEPTS OVERVIEW
2.1 Capability-Based Planning

In times of peace, the defense system operates as a complex system that must effectively utilize public resources to transform them into mission-ready armed forces. This transformation, along with the ongoing development and upkeep of the armed forces, is guided by defense policy and strategy. Defense policy outlines the desired objectives that the Defense Ministry aims to achieve, while defense strategy can be understood as the approach taken to accomplish these objectives.

Defense planning, which is guided by defense policy and strategy and relies on analytical, planning, and

programming efforts, determines the type of armed forces that are appropriate, feasible, and affordable for the nation (Mazarr et al., 2019). The purpose of defense planning is to convert national security and defense policy, as well as derivative defense strategies and guidance documents, into a practical and economically viable set of capability requirements, spending priorities, plans for capability development, programs, and budgets. Ultimately, this process results in the establishment of a comprehensive, accessible, and capable force structure that ensures the fulfillment of assigned defense tasks and the achievement of national defense and security objectives.

The primary challenge faced by defense planners is to determine the most optimal military capabilities to be developed and maintained, as well as the necessary states of readiness associated with them (Omitoogun & Hutchful, 2006). Two primary approaches to defense planning exist: threat-based planning (TBP) and capability-based planning (CBP) (Borzillo et al., 2021).

During the late 1990s, some defense experts started expressing concerns that the US Defense Department's force development plans were based on limited scenarios that failed to encompass the potential spectrum of future military engagements. This traditional method was referred to as "threat-based planning." At that time, the commonly utilized scenarios revolved around addressing a North Korean invasion of South Korea and an Iraqi assault on Saudi Arabia and Kuwait. However, during the period spanning from the mid-1990s to the early years of the twenty-first century, military forces were confronted with a multitude of varied challenges, often requiring simultaneous responses. Consequently, developers of military forces began advocating for the adoption of a broader range of realistic scenarios for planning purposes. One of the most comprehensive frameworks in this category was proposed by RAND analyst Paul Davis and his colleagues. Eventually, Davis termed his approach "capabilities-based planning" (Hicks, 2017).

As Troxell (2001), a professor at the U.S. Army War College noted, whether employing TBP or CBP, the force planner must achieve three main objectives. Firstly, they need to ascertain the required level of force structure to effectively respond to the anticipated challenges posed by the security environment while maintaining an acceptable level of risk. Secondly, they need to determine how to organize the force structure into units with appropriate allocated resources. Lastly, they must provide a justification to defense leadership, the national legislature, and the public, demonstrating that the solutions for the first two tasks are reasonably accurate and worthwhile

investments. To accomplish these three objectives, force planners can opt for either threat-based planning or capabilities-based planning (Troxell, 2001).

Threat-based planning is beneficial when threats are easily identifiable and can be described using one or a few plausible scenarios. In such cases, force planners assess the necessary force required to succeed in those scenarios while managing an acceptable level of risk (Troxell, 2001).

On the other hand, capabilities-based planning is most advantageous when threats and challenges are multifaceted, uncertain, and cannot be adequately captured by a limited number of scenarios (Troxell, 2001). According to Davis (2014, p. xiv), "[c]apabilities-based planning is planning under uncertainty to provide capabilities for a wide range of modern-day challenges and circumstances while working within an economic framework that necessitates choice." As for taking into account threats, Paul K. Davis noted, that "[w]hen done well, then, capabilities-based planning confronts uncertainty and the need to make choices within constrained budgets. Properly understood, it has always considered both generic possibilities and specific threats" (Davis, 2014, p. xiv).

To summarize, threat-based planning (TBP) has always focused on developing suitable capabilities to address the specific contingencies associated with identified threats. However, the underlying assumption in threat-based planning is that a force designed to effectively handle a few well-defined and understood threats would also be adequate to address less significant challenges from any other potential threats that may arise. On the other hand, capabilities-based planning (CBP) takes into account all threats and their associated contingencies that an armed force is expected to face. It aims to design the most efficient and affordable force structure possible. CBP operates on the implicit assumption that no single threat or a narrowly defined set of threats alone can adequately guide the design of a force required to respond to numerous and diverse challenges. The process of CBP should primarily concentrate on formulating a plan for the development of the desired force or capability. This involves identifying and prioritizing the necessary means or capability requirements, which are derived from analyzing strategic policy guidance, scenarios, and concepts. The goal is to develop the future force structure in alignment with the guidance provided by the Ministry of Defense and within the known fiscal limitations. It is crucial for the

capability planning process to be completed well in advance so that it can inform the subsequent programming and budgeting processes effectively.

2.2 Program Budgeting

Program budgeting is an advanced performance budgeting system implemented across the government, which effectively incorporates performance information during the formulation of the state budget (Robinson, 2013).

In the past, governments commonly employed a budgeting approach known as incremental "line-item" budgeting, which organized budgets based on specific organizational entities. Under this system, budgets were determined solely by input components such as wages, salaries, materials, supplies, and infrastructure. Funding decisions for these items were typically influenced by factors like inflation, expected economic growth rates, or policy changes impacting the organization's role and responsibilities. Since the mid-20th century, governments, particularly in the United States, have undertaken efforts to implement program budgeting. This shift primarily stemmed from the need for increased transparency regarding the allocation of funds. The aim was to provide a clearer understanding of how resources are allocated to achieve

specific results (both outputs and outcomes). This transition to program budgeting sought to ensure that resource allocation decisions were based on more comprehensive information regarding the resources necessary to accomplish specific objectives (Asian Development Bank, 2017).

A program can be defined as "a group of different types of output and/or transfer payments that have a common intended outcome together, possibly, with other common characteristics such as a single target group" (Robinson, 2013, p. 14).

Defining programs appropriately, along with other components within the program hierarchy, is essential for the effective functioning of a program budgeting system.

With regard to the defense ministry, the program structure serves as a strategic tool for managing finances and resources at the highest level. Properly structured and organized, defense budget programs play a crucial role in linking defense policy and strategy to budgetary allocations by carefully planning the distribution of available resources over a medium-term period, typically spanning four to six years. The collective allocation of resources aims to generate *outputs - military capabilities*, which are the necessary to achieve desired *outcomes - national defense policy objectives*.

The key aspect of an effective program budgeting system lies in properly defining programs and other

elements within the program hierarchy. The structure of defense programs can vary, and there is no one-size-fits-all approach. It can be organized based on military service or major defense organizations, types of forces, functional areas, major mission areas, or a combination of different approaches. The design choice for the defense ministry's program structure should align with the institution's goals and consider the existing culture, limitations, and capabilities (Taliaferro et al., 2017).

In the context of defense programs, it is essential to describe the force in quantifiable terms, considering both cost (inputs) and capabilities (outputs). This enables defense leaders to effectively manage both the financial aspects and the performance of these programs. It also provides them with the ability to compare the costs and benefits of various spending options and select the most effective ones. Moreover, the defense budget programs should adhere to the fundamental principle of being *results-based* to the greatest extent possible. They should be defined as *groups of outputs* (products or services) *delivered to external entities* that share *common outcomes* (resembling "product lines") (Robinson, 2013). In fact, every defense capability, whether related to combat, combat support, or general administrative functions, can be regarded as a program (subprogram/program element). As

Taliaferro et al. noted, a defense "…program is the combination of assets, activities, and services along with the financial inputs they require to produce a capability" (Taliaferro et al., 2017, p. 13-14).

According to Okromtchedlishvili (2022a, p. 94), "[t]he main output of a defense program is Military Capability as a comprehensive force structure consisting of its constituent force elements/capabilities (combat, combat support, combat service support, training, management, command and control) with an integrated set of aspects categorized as doctrine, organization, training, materiel, leadership development, personnel, and facilities, and with an appropriate readiness level assessed at a concrete time."

The output of a defense program refers to the overall military capability, which can be seen as the sum of capabilities provided by the various components of the Defense Forces.

The primary output of the defense program, the Military Capability, is provided to external parties, specifically the society that the defense forces serve, through both direct and indirect means. Directly, the defense forces support civil agencies in managing various emergencies or engage in military operations to defend against enemy aggression. Indirectly, the defense forces contribute to deterrence and

plays a role in reinforcing regional and international security.

The primary outcome expected from the Defense Program should be established based on the specific defense objectives or tasks outlined in the defense policy documents. These objectives typically include ensuring deterrence and defense, providing assistance to civil agencies in managing emergencies, contributing to the enhancement of regional and international security, etc.

It is important to highlight that an inadequate program design, coupled with a lack of clear alignment between allocated resources and the desired outputs or capabilities of force elements integrated with capability components, as well as the expected outcomes in the short- and mid-term perspective, can result in a disconnect between defense strategy, capability development, and budgeting. This mismatch may lead to defense forces that are either unaffordable or incapable of fulfilling their intended purpose.

Consequently, such a situation can undermine the overall efficiency and effectiveness of the defense resource management process. It can also result in a scenario where the planned or expended resources generate products or outputs that do not fully support the desired outcomes, namely the defense objectives or tasks established by the government. This can further manifest as the "watermelon effect," wherein the activities or outputs may meet certain predetermined targets, but the ultimate outcomes are either not achieved or only partially achieved.

If the defense program structure is not a *result (output/outcome)-based,* with military capability being a primary output and outcomes aligned with national defense objectives, the utilization of program budgeting in the defense sector loses its purpose as a tool to enhance the efficiency and effectiveness of defense resource management and becomes a mere simplification of budget allocation and utilization, without obtaining the essential advantages associated with program budgeting.

3. THE ROLE OF CAPABILITY-BASED PLANNING AND PROGRAM BUDGETING IN ENSURING THE SUSTAINABILITY AND UTILITY OF THE DEFENSE FORCES

3.1 Production Model of Performance in the Defense Sector

The foundation of the production model of performance in the defense sector (Okromtchedlishvili, 2022b) starts with defining the national

interests, security situation, threats, anticipated scenarios, and the establishment of national security and defense objectives and tasks. These aspects are documented in the National Security and Defense Policy papers. The issues related to national security and defense (1 in Figure 1) prompt defense planners and decision-makers to identify the necessary military capability requirements to achieve the defense objectives and tasks. They also need to prioritize these requirements based on the available resources (2).

According to the model, these priorities are then transformed into the objectives (3) of the specific defense program in question. By comparing the objectives with the identified needs (prioritized military capability requirements), an assessment can be made regarding the alignment and relevance of the pursued policy (7).
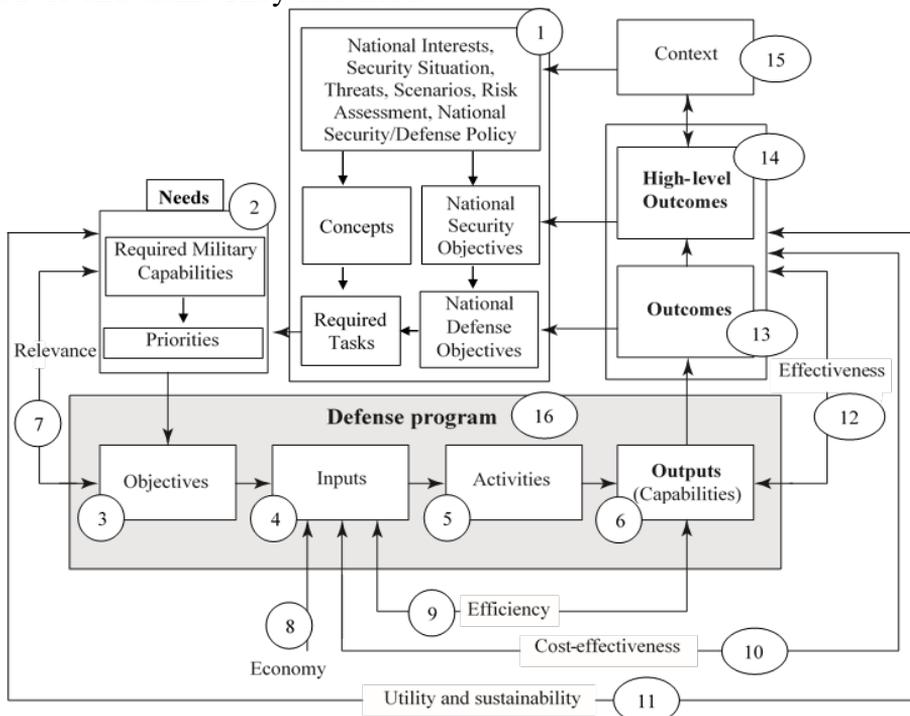
Fig. 1 Production Model of Performance in the Defense Sector
Source: Okromtchedlishvili (2022b)

3.1.1 Defense Outputs and Efficiency

Resources such as financial, material, and human inputs (4) are allocated to defense organizations and programs to facilitate their activities (5), which ultimately generate outputs or capabilities (6). The economy (8) refers to the relationship between monetary inputs

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and other inputs, such as the cost of vehicles, weapon systems, or uniforms. Efficiency (9) is the measure of how effectively inputs are utilized in relation to outputs. According to Omitoogun & Hutchful (2006), efficiency denotes achieving the optimal output for a given input, thereby obtaining the best value for money. Economists distinguish between efficiency and productivity, where productivity is defined as the ratio of input to output. It is worth noting that financial profit maximization is not the objective of public sector organizations, including the Ministry of Defense. However, the MOD still needs to evaluate its output mix. Defense decision-makers and planners should also consider and evaluate whether they are providing the appropriate combination of outputs or capabilities (force elements).

3.1.2 Defense Outcomes and Effectiveness

The outcomes of public services, including defense, often have a collective nature or consist of externalities that are not accounted for by individual consumers. Unlike market transactions, citizens do not directly pay for the services they receive, such as air defense provided by the Air Defense Forces. As a result, citizens cannot evaluate these services by assigning monetary values to them. Instead, in democratic societies, citizens can indirectly assess public services through political participation, as explained in the principal-agent theory (Hartley, 2012).

Defense, with its primary desired outcome of deterrence and defense, serves as a classic example of a non-competitive and non-exclusive public good. For instance, when residing as neighbors in the same city, the consumption of air defense services by some individuals does not impact the consumption of others. Once provided, no one can be excluded from benefiting from these services (Hartley, 2012).

Researchers in public administration have examined the concept of outcomes. Outcomes can be intermediate (13 in Figure 1), or final/high-level, usually in the long term (14). These outcomes are often influenced by contextual factors (15), which the organization or program has limited or no control over. These contextual factors may include socio-economic or environmental trends, as well as policies implemented by other governments. For example, agencies in European Union member states are bound by European regulations. In the case of the Ministry of Defense, contextual factors may include trends in regional or global security, relationships with strategic partners and adversaries, changes in the domestic or international political landscape, breakthrough technological innovations affecting the methods of armed struggle, and more. The effectiveness (12) is the ratio of outputs to outcomes, while cost-effectiveness (10) represents the ratio

of inputs to outcomes. The outcomes of a program or organization must address the needs of society, such as providing deterrence against potential adversaries, ensuring defense in the face of aggression, supporting civil agencies in handling emergencies, and safeguarding sovereignty and territorial integrity. *Evaluating the alignment between needs and outcomes allows for the assessment of the sustainability and utility (11) of the program or organization.*

The alignment of needs, required capabilities (2), produced capabilities or outputs (6), and outcomes or national defense objectives (13) *significantly enhances the sustainability and utility* (11) of a defense program or organization.

3.2 Summary

In fact, all the processes described in the proposed Production Model of Performance in the Defense Sector are integral parts of capability-based planning (CBP) and program budgeting (PB) processes. The primary goal of the CBP process is to formulate a comprehensive plan for creating the desired force structure or military capability. This involves identifying and prioritizing the necessary capability requirements, which are determined through the analysis of strategic policy guidance, scenarios, and concepts. Subsequently, these prioritized capability requirements are translated into the objectives of the specific defense program. As a result, the PB process generates the desired capabilities or outputs, thereby contributing to the accomplishment of the National Defense objectives or outcomes.

Therefore, when implemented and executed effectively, CBP and PB play a critical role in establishing the necessary alignment between required capabilities, produced capabilities or outputs, and the desired outcomes outlined by the National Defense objectives. This, in turn, facilitates the enhancement of sustainability and utility of Defense Forces.

4. CONCLUSION

Capability-based planning (CBP) and program budgeting (PB) are powerful tools that can significantly contribute to the sustainability and utility of defense forces. The adoption of CBP enables defense organizations to prioritize and allocate resources based on the desired capabilities necessary to achieve strategic objectives. By focusing on the development of a comprehensive plan for the desired force structure or military capability, CBP ensures that defense forces are well-equipped, adaptable, and responsive to a wide range of potential threats and challenges.

Program budgeting, on the other hand, shifts the focus from traditional line-item budgets to allocating resources based on specific programs and focuses on results rather than inputs. This approach enhances

transparency, accountability, and performance measurement by aligning funding with outputs and outcomes. Through program budgeting, defense organizations can make more informed decisions regarding resource allocation, prioritize high-priority programs, and optimize the utilization of available resources over a medium-term period.

When implemented together, CBP and PB establish a crucial alignment between required capabilities, produced capabilities or outputs, and the desired outcomes outlined by national defense objectives. This alignment enhances the effectiveness and efficiency of the defense resource management process, ensuring that resources are allocated strategically and produce the desired military capabilities. It also enables defense decision-makers to evaluate and optimize the output mix of defense programs, considering both cost and capabilities.

It is important to recognize that defense outcomes, such as deterrence and defense, are collective and non-exclusive public goods. Citizens cannot directly assign monetary values to these outcomes, but their assessment can be conducted indirectly through political participation. By addressing societal needs and providing outcomes that align with national defense objectives, defense

organizations can enhance their sustainability and utility.

In conclusion, the adoption of capability-based planning and program budgeting in the defense sector is crucial for achieving effective resource allocation, strategic planning, and desired defense outputs and outcomes. These approaches facilitate the alignment of capabilities (outputs), and national defense objectives (outcomes), leading to a more sustainable, efficient and effective defense forces that can effectively address evolving security challenges.

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EMERGING AND DISRUPTIVE TECHNOLOGY TRENDS IN DEFENSE AND SECURITY

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In order to be able to identify technological trends in the field of defense and security, different scenarios are carried out, analyzes over certain time horizons, in-depth analyzes of ongoing research, but also estimates that are based on the opinions of experts in the field. In this endeavor, I had as the objective of the scientific research to obtain an overview of the trends of emerging and disruptive technologies relevant in the fields of defense and security, considering the current regional context. The effort was focused on the assessment of emerging and disruptive technologies, based on research and analysis of recent available literature in the field. I have come up with clarifications on defining the emerging, disruptive technologies and their convergence, the trends in the context of hybrid warfare, as well as the most promising and relevant technologies that can be applied on a large scale and are going to influence the fields of defense and security.

Key words: *emerging technologies, disruptive technologies; hybrid warfare; defense and security.*

1. DEFINITIONS AND CLARIFICATIONS

Emerging and disruptive technologies are a topic of recent debate, both in the field of academic research and at the political-military level and in the business environment, which aims at their development and implementation. The proof of the importance of the phenomenon represented by emerging and disruptive technologies is found in the mediatization of the concept, the increased number of debates, articles, scientific conference, etc.

In the reference work *What is an emerging technology?* the authors identified five key attributes that qualify a technology as emerging: radical novelty, relatively rapid growth, coherence, prominent impact, and uncertainty and ambiguity (Rotolo et al., 2015). From the authors' perspective, they agreed that emerging technologies represent: *"a radically novel and*

relatively fast growing technology characterized by a certain degree of coherence persisting over time and with the potential to exert a considerable impact on the socio-economic domain(s) which is observed in terms of the composition of actors, institutions and patterns of interactions among those, along with the associated knowledge production processes. Its most prominent impact, however, lies in the future and so in the emergence phase is still somewhat uncertain and ambiguous" (Rotolo et al., 2015, p.4). At different points in time, each technology seemed to bring something radically new to its field of applicability, even though the idea (theoretical concept) itself already existed.

The search for newer and newer innovations can also lead to disillusionment Any new technology, from discovery to maturity, is characterized by a lot of uncertainty. Figure 1 depicts 3 "S" curves for the life cycles of 3 types of technologies. "S" curves illustrate that uncertainty arises because: the technology is radical, the technology is early in its life cycle, or because of the increasingly unclear nature of security threats.
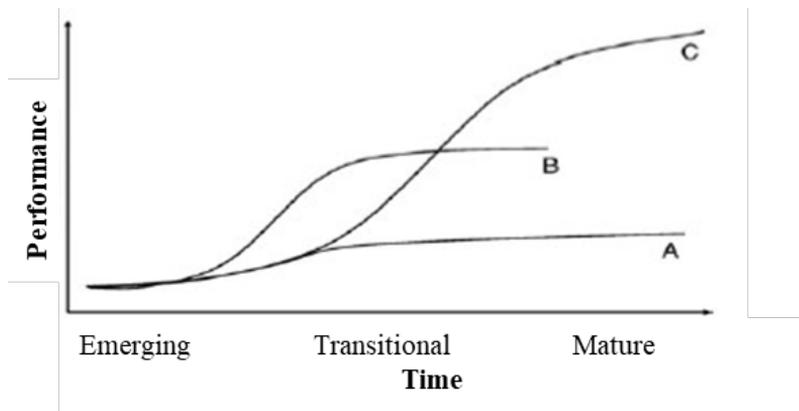
Fig. 1 Emerging technologies and the nature of technological innovation (James: 2016, p.14)

Curve A highlights that some technologies may fail to deliver the performance requirements expected by developers because technological or engineering issues may arise that are difficult to overcome in a short time or without additional resources.

Curve B illustrates a situation where a technology is being replaced by other technologies that are better, cheaper, or benefiting from a faster rate of development. The longer it takes for a technology to be validated and certified, the more

likely it is that new ones will emerge.

Curve C highlights that only some technologies will reach the stage where they will be mature enough to be considered for the transition to new military capabilities. But here comes the question of the cost of designing the emerging technology versus the benefits and effects produced.

A clarification of the meaning of emerging technology is found in the report *Emerging technology trends for defense and security*, where emerging technologies are considered *"technologies with low maturity or technology readiness level (TRL), currently in development"* (Andas: 2020, p.9). In other words, these technologies exist, but not on a large scale, being still in the stage of validation and recognition of potential. Also, this report presents the meaning of the terms convergent and disruptive technology, which may cause effects as a result of emerging technologies, as follows:

– *"Technology convergence involves merging of existing technologies in order to create new and better possibilities and allows development and maturation"* (Andas: 2020, p.9). It can be understood that by joining emerging technologies with already validated technologies, these improved technologies will result in superior effects.

– *"Disruptive technologies in the context of defence and security are technological developments that change the conduct of conflict and the rules of engagement"* (Andas: 2020, p.9). These technologies are mature and can make a difference on the battlefield.

The relationship of emerging - convergent - disruptive technologies can be found in the example of the *tank* (Andas: 2020, p.9). The emergence of armored vehicles took place at the beginning of the 20th century. The advances achieved in the First World War were due to the convergence with some technologies, such as tracks, armor, motorization, etc. which had a significant impact on the battlefield, which practically ensured the transition to the maturation of what the tank was to represent. The maturation of the tank occurred in the period between the two world wars, with the convergence of combat platforms and the command-control that was achieved by equipping it with radio stations. This combination as well as the doctrinal updates produced a disruptive effect at the beginning of World War II materialized by the blitzkrieg attacks carried out by the German army.

2. EMERGING AND DISRUPTIVE TECHNOLOGY TRENDS IN HYBRID WARFARE

Hybrid warfare is a topical notion in military science research and international studies of modern warfare and threats, and refers to the use of unconventional methods, as part of a multi-domain conflict-based approach, to disrupt and shape the actions of an adversary.

This is not an anomaly in the conduct of wars, but rather a transition, combining elements of the old and new generations of warfare. Hybrid warfare is preferred for various reasons: the adversary force is superior, to avoid international sanctions or to maintain a *"hot zone"* for a long time in a region, etc. As a rule, hybrid operations do not ensure a final victory. If an army is not able to also sustain classic military operations when the situation requires it, it cannot win the war. The transition from irregular hostile actions to classic combat operations and vice versa is actually characterized by the combination of the two, i.e. hybrid warfare.

In time, hybrid warfare will become a normality in the military actions, and the planning and decision-making process will pay more attention to the unconventional elements present in a classical war.

Hybrid warfare can provide the element of surprise in an operational environment, and disruptive technologies will help surprise and breaking an enemy's rhythm.

New technologies also bring new threats, both militarily and to civil society. *"We are increasingly confronted by cyber, hybrid, and other asymmetric threats, including disinformation campaigns, and by the malicious use of ever-more sophisticated emerging and disruptive technologies"* (Brussels Summit Communique: 2021), it was mentioned in the press release of the Brussels NATO summit of June 14, 2021. NATO leaders determined the *Emerging and Disruptive Technology Implementation Roadmap,* as early as 2019 at the London summit and the approval by the defense ministers of the NATO member states of the *NATO Coherent Implementation Strategy on Emerging and Disruptive Technologies* in 2021. Also, in 2021, *Defense Innovation Accelerator for the North Atlantic – DIANA* was launched. NATO's innovation activities focus on the following priority areas: artificial intelligence, autonomy, quantum, biotechnologies, hypersonic systems, space, novel materials and manufacturing, energy and propulsion, next-generation communications networks

(Emerging and disruptive technologies: 2023).

Simona R. Soare, expert in defense and military analysis at IISS (International Institute for Strategic Studies), proposes five steps that could transform NATO in an innovator at a strategic level through *"establishing a NATO civil-military technology assessment capability; prioritizing systemic innovation targets; setting ambitious benchmarks linking innovation to capability development, deterrence, defense, and resilience; doubling down on collaborative innovation so that no ally gets left behind in the innovation competition; and committing to more ambitious NATO-EU cooperation"* (Soare: 2021, pp. 2-3). Technological progress will change the way future wars go, given the actors that are involved, the place where these new types of conflicts unfold, and especially the speed at which they are carried out and their hybrid character.

The challenge for NATO member states is the *"step forward"* that must exist in the face of state or non-state actors that could create instability by using such high-impact technologies. The cooperation in the field of civil-military research, the management of problems at NATO or EU level through specialized agencies, the creation of response mechanisms and procedures, etc. can

ensure the necessary advance in front of the opponents. The rush to discover new possible emerging and disruptive technologies is a different Cold War of nowadays, even if this time at global level. The great economic and military powers are caught up in this research, innovation and arms race. The international context, with a conflict of aggression by the Russian Federation on Ukraine, with many unstable regions or on the verge of becoming potential outbreaks of insecurity should exercise the greatest caution in the implementation of technological innovations with disruptive ramifications. The UN High Representative for Disarmament Affairs highlighted several major trends in the risk of conflict in the context of emerging and disruptive technologies. One of the trends that he drew attention to is related to *„the emerging nature of warfare enabled by networked militaries, autonomy, uncrewed vehicles, advanced sensors, and weapons that can attack at hypersonic speeds"* (Nakamitsu: 2019, p. 1).

A 2020 US report discussed how emerging technologies are integrated into military forces and concepts of operation, the interactions between emerging technologies, and the extent to which national policies and international law enable or inhibit their development, integration and

use (Sayler:2020, pp. 23-24). This report provides an overview and military implications of emerging military technologies from the US, China, and Russia, the three major military competitors, on artificial intelligence, lethal autonomous weapons, hypersonic weapons, directed energy weapons, biotechnology, and quantum technology.

Perhaps more than ever, the promotion of these emerging and disruptive technologies on the battlefield will have decisive implications for future hybrid military conflicts. Even if the physical presence of the military will decrease on the battlefield, efficiency in battle, the rhythm of defense/offensive, the ability to analyze the real situation may have destabilizing consequences.

In the National Defence Strategy for 2020-2024, a series of risks and threats are identified in the area of emerging technologies, to which Romania must respond: *"The exponential trend towards development of emerging technologies (5G, artificial intelligence, big data, the Internet of Things, cloud and smart computing) generates both the need to increase and improve communications that will support innovative digital services designed to assist citizens and business environment, and the need to collect and secure all data*

and information circulating in those systems" (National Defence Strategy: 2020, p.19). As a benchmark regarding the future directions of research, development and implementation of emerging and disruptive technologies at the national level will be *"hypersonic vectors, 5G, quantum communication infrastructures, laser and electromagnetic applications, air and underwater monitoring equipment, artificial intelligence, autonomous platforms"* (National Defence Strategy: 2020, p.21). The Defense White Paper mentions the fact that among the main directions for the development of defense capabilities, the Romanian Army will also have as its direction of action *"capitalizing on the potential of emerging and disruptive technologies on the development and use of the armed forces"* (Defense White Paper: 2021, p.24). Moreover, Romania's Military Strategy specifies that the endowment of the Romanian Army will follow, among other things: *"the acquisition of weapons systems and equipment for military use using innovative, emerging and disruptive technologies"* (Military Strategy of Romania: 2021, p.25).

3. THE IMPACT OF EMERGING AND DISRUPTIVE TECHNOLOGIES ON DEFENSE AND SECURITY

The development of emerging and disruptive technologies will be able to ensure opponents' deterrence instead of needing effective defense. These technologies know no limits, nor is their strategic value fully known, but the idea that some of them could have an effect equivalent to that of a nuclear weapon should not be ruled out. The comparison does not refer to physical or destructive effects, but to the long effects on humanity In this reality, there is a need to adopt new mechanisms, not only in the field of production, possession and use of new technologies, but also in the control of their exports, mechanisms based on comprehensive legislation and regulations applicable to current trends (Popescu: 2021).

NATO updated the Strategic Concept at the Madrid summit (2022), noting that *"Emerging and disruptive technologies bring both opportunities and risks. They are altering the character of conflict, acquiring greater strategic importance and becoming key arenas of global competition. Technological primacy increasingly influences success on the battlefield"* (NATO 2022 Strategic Concept: 2022, p.5). In the *NATO Science & Technology Trends 2023-2043 Report*, emerging, disruptive and converging technologies are mentioned with a perspective on the next 20 years (figure 2).

Disruptive Technologies
- Big Data, Information and Communication Technologies
- Artificial Intelligence
- Robotics and Autonomous Systems
- Space
- Hypersonics
- Energy and Propulsion
- Electronics and Electromagnetics

Emergent Technologies
- Quantum
- Bio and Human Enhancement Technologies
- (Novel) Materials and Advanced Manufacturing

Convergence, Inter-Dependencies and Synergies
- Date – AI– Autonomy
- Date – Quantum
- Space – Hypersonics – Materials
- Space – Quantum
- Date – AI – Biotehnologii
- Date – AI – Materials
- Energy – Materials – AI

Fig. 2 Emerging, disruptive technologies and their convergence (Reding et al., 2023) - extract

An analysis of the current state of the technologies mentioned in figure 2 helps us to understand the importance given by NATO member countries to the convergence, interdependence and synergy between emerging and disruptive technologies.

Military art is influenced and must be adapted to what new technologies represent in the military field. In the article *Impact of new technologies on military art - specialist study*, attention is paid to the convergence of two or more emerging technologies in influencing military art and leading military actions. The author argues that *"As far as the command-control function is concerned, artificial intelligence is a focal point, in the sense that, once matured, it can be the core that coagulates the advantages offered by many of the analyzed technologies, but also by others, when they might be operationalized. Big data, which aims to manage large volumes of data, can facilitate fast and efficient "learning" that allows the system to quickly adapt to new situations. Quantum technology, through the characteristics it promises, can give it a significantly higher data processing speed, given the enormous computing capacity, secure transmission of data in the network, as well as detection capabilities that exceed the laws of classical physics. Unmanned vehicle systems on board add the ability to*

project force in an unprecedented way to the command-and-control system equipped with artificial intelligence, by making them autonomous, both from the point of view of movement and from the point of view of generating effects on the target (detection - selection - employment; monitoring - surveillance; jamming, etc.)" (Cîrciumaru: 2021, p.9).

The superior capacity of convergence between emerging and disruptive technologies will help achieve effects (Defence Technology Framework: 2019), such as:

– *enhanced lethality and mass effects* – projected hard power meant to defeat opponents in multiple areas;

– *improved protection* – an adequate capability that is agile, robust, maneuverable and able to provide persistent effects;

– *superiority in decision-making* – collecting, analyzing and understanding data more efficiently and at increased speeds to quickly identify threats, opportunities and options;

– *operational tempo* – it process and share information more efficiently to act quickly, collaboratively, and at a rate that adversaries cannot match, in complex and unpredictable ways;

– *resilience enablers* – increased support for the future force through

logistics, medical treatment, and better information;
– *sub threshold activities* – increased availability of legal and ethical opportunities to react, detect and respond to adversarial actions below the threshold of conventional war.

Some of the emerging or disruptive technologies may be within the reach of many states, especially those with low costs. Drones are proving to be weapons that have not yet reached their full potential, and yet they can penetrate enemy defenses, gather information about the adversary, supplement the activities of the military, etc. The convergence of technologies can create imbalances in the conduct of battle, with surprising effects. For example, a technology such as artificial intelligence could be associated with quantum computing to produce more powerful autonomous learning methods, leading to improvements in image recognition and target identification, or the development of more complexed autonomous weapons (Sayler: 2020). Technological innovations have been capitalized on in the way conflicts are conducted, influencing military tactics and doctrines over time. Military strategists that embraced the new technologies gained supremacy on the battlefield over those who were conservative or complacent with out-of-date ideas.

Figure 3 (a, b, c, d) shows 4 graphs with information for the period 2018-2021 regarding the leading states in the field for some of the essential disruptive technologies: Data, Artificial Intelligence, Space and Electronics and Electromagnetics.
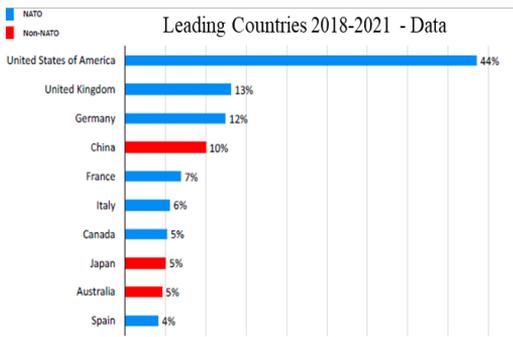
Figura a. Big Data, Advanced Analytics and Information Communication Technologies (Data)
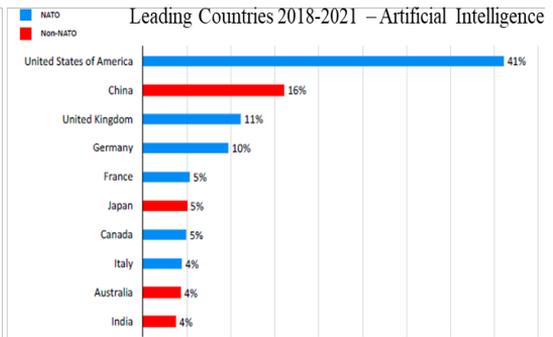
Figura b. Artificial Intelligence
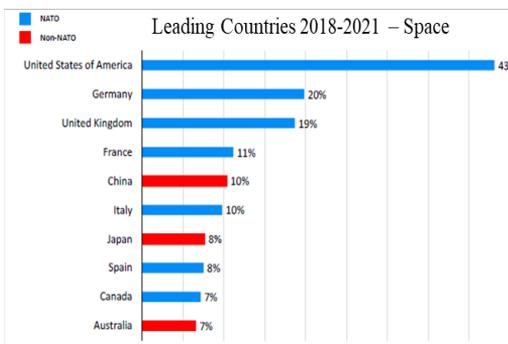
Figura c. Space Technologies
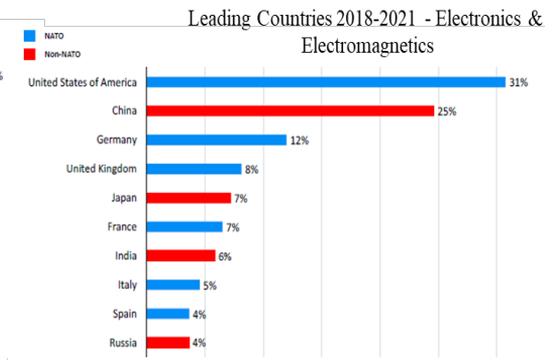
Figura d. Electronics & Electromagnetics (E&EM)

Fig. 3 Leading States in Key Disruptive Technologies (Reding et al., 2023) - extract

The analysis of the graphs reveals that the United States of America is the leader in the field on all 4 analyzed components, with percentages of over 30%. Another observation is that of the top 10 leading countries in the field, most are NATO members, which indicates the increased interest in the military field in the area of disruptive technologies. These analyzes were determined by the concerns of top institutions regarding scientific and technological research in NATO states, on the fields mentioned in figure 3.

4. CONCLUSIONS

Emerging technologies in the field of defense and security have a major influence on military operations, and the convergence of new technologies with existing ones have disruptive effects, being capable of generating effects of

optimization and effectiveness of some combat systems, of amplifying performances in time-limited situations or decision-making under conditions of uncertainty.

Any war with new generation technologies will not completely replace previous generations. The nature of war will not change because of this change. The methods and techniques of warfare are adapted according to the performance of the equipment; the implementation of new concepts is determined by previous experiences and the way of action of the enemy. The current conflict in Ukraine is proof that infantry fighting vehicles, tanks, artillery, aircraft, etc. are combined with new technologies such as UAVs, satellites, HIMARS systems (High Mobility Artillery Rocket System), etc., in other words, the classic generation of warfare will not disappear due to the appearance of a new one, but will actually merge with it.

Emerging and disruptive technologies have the potential to change the balance of power and create new forms of insecurity. Military doctrines and strategies should be revised much more frequently to meet new challenges that may have profound military implications. The convergence of two or more technologies can replace the supremacy of established equipment.

Coincidence or not, the last decade has seen a lot of regional and global security and defense events such as the competition for scarce resources, the withdrawal from Afghanistan (2021), the COVID 19 pandemic and the resulting instability, the aggression of the Russian Federation on Ukraine (2014, 2022), China's intention to control Taiwan, etc. What could happen next? There will certainly be consequences, as a result of the multiple events of the last 10 years. Emerging and disruptive technologies will be able to solve some problems of the past, in the future, with a major impact on security and defense, by countering hybrid risks and threats.

I believe that the current emulation around emerging and disruptive technologies so often voiced is actually another kind of *arms race.*

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SHOULD A PRODUCTION RATE VARIABLE BE INCLUDED IN MILITARY AIRCRAFT LEARNING CURVES? EMPIRICAL EVIDENCE FROM THE UNITED STATES AIR FORCE

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Learning curves are a core analytical method employed by cost analysts to estimate weapon system production costs. This study examines United States Air Force aircraft programs and compares the traditional (e.g., Unit Theory) learning curve model to a production rate learning curve model. While there are some previous studies examining production rate models, one novelty of this research is the size of the dataset, which comprises the largest military examination to date. The results suggest the production rate model outperforms the traditional learning curve model. Additionally, the analysis identifies the post-Initial Operational Capability (IOC) time period as the preferred milestone in the life-cycle to employ the production rate model.

Key words: *learning curve, production rate, cost estimating, cost modeling, resource allocation, defense budgets*

1. INTRODUCTION

Defense cost analysts employ a multitude of techniques to estimate the cost of a weapon system. One of the most widely accepted and utilized techniques is the learning curve. Learning curves are traditionally used to estimate recurring costs in a production process (Mislick and Nussbaum, 2015). While learning curves have been studied along a multitude of dimensions (Boone et al., 2021; Moore et al., 2022), empirical examinations incorporating a production rate (PR) variable in defense programs is sparse. The

purpose of including a PR variable is to capture cost reductions that are realized through economies of scale (Government Accountability Office, 2020). However, the mixed results in the extant literature has led to some debate on whether the PR variable should be employed in cost estimates. Therefore, we examine the evidence in United States Air Force (USAF) aircraft to shed light on the issue.

To the best of our knowledge, this study utilizes the largest USAF learning curve dataset ever collected. The robust dataset enables comparisons between traditional (e.g., Unit Theory) learning curve models and a PR learning curve. Thus, the purpose of this article is two-fold: 1) To discern *if* a PR model is preferred in USAF programs and 2) To determine *when*, in the acquisition process timeline, a PR model should be employed.

Military aircraft are expensive. Unfortunately, cost growth has historically plagued these programs (Jones et al., 2023). Improving the toolkit for defense cost analysts is one small step towards better estimates and reducing future cost growth. This has implications for defense resource management in the form of better informed decisions and the resultant improvement in resource allocation.

2. LEARNING CURVES AND THE PRODUCTION RATE MODEL

Learning curves are routinely used to estimate recurring manufacturing costs in a multitude of industries (Womer, 1979). Defense cost analysts widely adopted these learning curve methodologies after Wright's (1936) and Crawford's (1947) seminal studies.

Wright's (1936) analysis of World War I aircraft production costs revealed a mathematical relationship between the quantity produced and the amount of labor hours (or cost) needed to complete the task. More specifically, Wright found that as the quantity of units produced doubled, the *cumulative average cost* decreased by a constant percentage. This insight became known in the learning curve vernacular as Cumulative Average Theory or the Wright Curve.

Crawford (1947) subsequently found a similar relationship in his study using World War II aircraft production costs. The USAF commissioned his study to validate Wright's theory (Mislick and Nussbaum, 2015). Crawford found that as the quantity of units produced doubled, the *individual unit cost* decreased by a constant percentage. This insight became known in

learning curve vernacular as Unit Theory.

Mathematically, the formulation of Wright's and Crawford's curves are the same. Differences lie solely in the interpretation of the variables themselves. This paper employs Unit Theory (or the Crawford curve) as it is the more common technique used by US defense cost analysts in estimating recurring aircraft costs. Equation 1 denotes the traditional Unit Theory model.

$$Y = AX^b \qquad \text{Equation 1}$$

Where:

Y = the cost of unit X

A = the theoretical cost of unit one (T1)

X = the unit number

b = a constant representing the slope of the learning curve

Learning curves capture the expected unit cost decrease as additional quantities are produced. But it is also reasonable to expect unit costs to decrease as the production rate increases (Government Accountability Office, 2020). This is known as the PR effect.

The PR effect is in addition to the learning curve effect. It captures cost reductions realized through economies of scale (Government Accountability Office, 2020). Banks et al. (2016) attribute the PR effect to large fixed costs inherent in defense systems. The Government Accountability Office (2020) identifies specific examples where economies of scale can occur, such as quantity discounts, reduced ordering, processing, shipping, receiving, and inspection costs.

Regardless of the specific source, the impact of the PR effect is similar to the learning curve effect in that unit costs decrease as quantities increase. Where the PR effect differs from learning curves is that it lacks "memory" (Banks et al., 2016). In other words, the PR only affects a specific lot's unit cost. The PR impact does not carry over to the next production lot (Banks et al., 2016).

Large et al. (1974) is the first known defense report that explicitly models the PR effect. Their equation has been replicated by multiple outlets since that time, with slight changes in the PR variable nomenclature. See Equation 2.

$$Y = AX^b R^c \qquad \text{Equation 2}$$

Where:

Y = the cost of unit X

A = the theoretical cost of unit one (T1)

X = the unit number

b = a constant representing the slope of the learning curve

R = production rate (quantity per time period or lot)

c = rate coefficient

In summary, Figure 1 depicts the traditional Unit Theory learning curve on the left and the PR model on the right. Incorporation of the rate variable results in lower costs, as the slope of the curve is steeper. The empirical comparison of these two models with USAF data is the genesis of this paper.
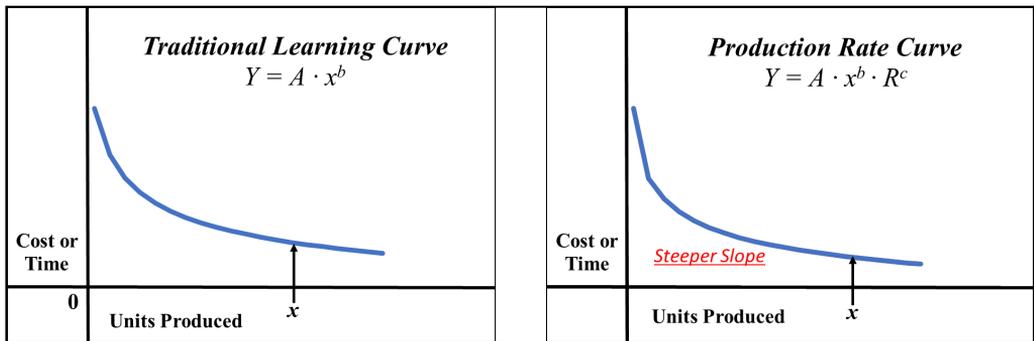
Fig. 1 Unit Theory and PR Model

2.1. Previous PR Studies

Although Large et al. (1974) are not the first to discuss the PR theory, their mathematical modeling of the concept consistently appears in the literature as a seminal contribution. Somewhat ironically, Large et al. (1974) found that a generalized estimating equation was not reliable in their dataset of 29 aircraft. Rather, while they believed the PR theory generally holds, they concluded that in any specific instance the effect depends upon the circumstances leading to a rate change. As a result, they suggest that each case must be evaluated individually prior to usage.

In contrast, subsequent studies by Smith (1976) and Congleton and Kinton (1977) both found statistically significant relationships between production rate and direct labor hours.

Both of these studies were limited in scope, but they inspired Bemis (1981) to examine the PR model further.

Bemis (1981) used Selective Acquisition Reports (SARs) from the 1950s to 1970s for his investigation. His empirical analysis on historical and on-going aircraft resulted in a recommendation for PR to be considered in defense cost estimates.

Moses (1990) acknowledged these inconsistent findings within the literature and attempted to discern a set of conditions under which a PR model is preferred. He found neither model dominated under all conditions. Rather, the PR model outperformed when there were large fixed costs, a growing production rate trend, or large variability in period-to-period production rates.

A more recent study by Arena et al. (2008) found some evidence of higher production rates reducing costs in fixed-wing aircraft. While Banks et al. (2016) noted that PR effects were strongest in high quantity systems such as missiles. Notably, their study was limited by the small dataset of 11 defense systems. Lastly, Boone et al. (2021) were not directly testing for a PR model, but their findings are still relevant to this research. Boone's suggested modification to the Wright curve results in a steeper slope during early production lots. This idea of a steeper curve is commensurate with the PR effect.

In summary, the previous PR study results are mixed. The majority of studies point to PR being an important consideration in future cost estimates. But many of these studies suffer from small datasets and/or the analyses were conducted decades ago. This endeavor seeks to fill that gap by utilizing the most robust, modern military aircraft dataset collected to date.

3. DATA AND METHODS

3.1 Data

The data is sourced from Contractor Cost Data Summary Reports (CDSR), or DD 1921-2s (progress curve reports), through the Cost and Economics Division (FZC) of the Life Cycle Management Center (LCMC) at Wright-Patterson Air Force Base, Ohio. The 1921-2 report captures recurring costs by unit or lot for selected reporting elements (Department of Defense, 2021). The original dataset included 158 aircraft programs with 813 production lots. Table 1 shows the final dataset after applying an exclusion criteria screening. The red font indicates removal of lots or programs.

Table 1 Dataset

	Number of Lots	Number of Programs
Original Dataset	813	158
Less than 3 Units per Lot	46	0
Missing Data	49	26
Lack of Sequential Lots	125	56
Non-Aircraft	53	8
Final Dataset	**540**	**68**

The first exclusion criterion removes aircraft that had less than three units in a production lot. This criterion is consistent with Arena et al. (2008) who suggest a minimum lot size of three is needed to consider a PR variable as part of the learning curve model. The second exclusion criterion removes 26 programs that have missing data. The third criterion removes 56 programs that did not have sequential production lots or had less than 4 sequential

lots. Sufficient sequential lots are necessary to model learning curves. The fourth and final exclusion criterion removes eight non-aircraft programs. These rotary wing and missile systems are outside the aircraft-centric focus of this analysis. The final dataset, therefore, consists of 68 programs comprised of 540 lots.

The 1921-2s report actual expenditure costs. These are referred to as Then Year expenditure (TY exp) dollars (Office of the Secretary of Defense, Cost Assessment and Evaluation [OSD-CAPE], 2021). Best practices necessitate normalization to Constant Price (CP) dollars prior to modeling and analysis (OSD-CAPE, 2021). Thus, the OSD published Raw Inflation Rates for aircraft procurement (3010 appropriation) were utilized to convert the 1921-2 TY exp data into CP dollars.

3.2 Method - Comparing Models

The first investigative question seeks to determine if a PR model is preferred to the traditional learning curve. To discern this requires several steps. First, the *traditional learning curve model* ($Y = AX^b$) from Equation 1 is transformed into log-log space and Ordinary Least Squares (OLS) regression is performed on each program. Because the 1921-2 data is in lot format, rather than individual units, the Y variable is the Average Unit Cost (AUC) and the X variable is the Lot Midpoint.

Next, the Absolute Percentage Error (APE) is calculated from the regression model output. The APE is calculated as shown in Equation 3. Note that the predicted AUC comes from the regression model while the actual AUC originates from the dataset.

$$APE = \left| \frac{AUC\,(Actual) - AUC\,(Predicted)}{AUC\,(Actual)} \right| \quad \textbf{Equation 3}$$

The APE data is then used to calculate a median APE (MdAPE) and mean APE (MAPE). These metrics will be used in subsequent tests (to be discussed) when comparing the traditional and PR models.

Lastly, the OLS regressions, APE, MdAPE, and MAPE calculations are duplicated for each program, but this time employing the *PR model* ($Y = AX^b R^c$) from Equation 2. With both the traditional and PR model data compiled, testing between the two approaches can occur.

Model comparisons are conducted via two methods. The first method utilizes a confidence interval. The MdAPEs from the traditional and PR models are differenced. Then a histogram is created from the differenced MdAPEs and its' associated confidence interval is calculated. If the confidence interval does not contain zero, then the

traditional and PR models are different.

The second method employs the Wilcoxon Signed Rank test. The Wilcoxon Signed Rank test is a non-parametric test for matched or paired data like the Sign test, but also considers the magnitude of the observed differences (LaMorte, 2017). Like the Sign test, the hypothesis for the Wilcoxon Signed Rank test uses the sample's locations (often interpreted as the median for similar distributions) of the difference scores. The hypothesis for the Wilcoxon Signed Rank test is:

H_0: the median of the population of differences between the paired data $= 0$

H_a: the median of the population of differences between the paired data $\neq 0$

In other words, the Wilcoxon Signed Rank test determines whether there is a statistical difference between the traditional and PR models.

3.3 Method – Acquisition Timeline

The second investigative question seeks to determine when, in the acquisition process timeline, the PR model should be employed. The Initial Operational Capability (IOC) date is chosen as the point of demarcation for the analysis. The IOC was chosen because it is a focal point in the acquisition timeline. IOC denotes the point where a system is ready to perform its intended mission in an operational environment with an initial quantity of assets (AcqNotes, 2023).

Table 2 illuminates the mapping process employed to answer this question. The lot where the PR model becomes statistically significant is mapped in 10 percent increments (positive or negative) from the IOC date.

Table 2 IOC% Mapping Example

IOC% Model Example (0% is IOC)							
IOC %	-30	-20	-10	0	10	20	30
Program #1	X						
Program #2				X			
Program #3		X					
Program #4					X		
Program #5				X			
Program #6		X					
Program #7							X
Sub-Total	1	2	0	2	1	0	1

A histogram is then compiled from the data in Table 2. Descriptive statistics from the histogram provide the mean, median, and 95% confidence interval. Lastly, a Wilcoxon Ranked Sign test is performed to determine whether the PR model occurs at IOC vice a point in time before (or after) IOC.

4. RESULTS

4.1 Comparison of Traditional and PR Models

There were 68 programs modeled with the traditional, $Y = AX^b$ learning curve construct. The data was transformed into log-space and OLS regression was run. Each program's prediction value for the dependent variable was then compared to its original value to calculate the APE within each program. Next, the process was duplicated for the PR model. A sample from the calculations are shown in Table 3.

Table 3 Sample Calculations

Prog ram	Traditional		PR		MAPE Difference	MdAPE Difference
	MAPE	MdAPE	MAPE	MdAPE		
Pgm. 1	1.8%	1.6%	1.8%	1.7%	7%	0%
Pgm. 2	4.3%	2.4%	4.4%	2.3%	-7%	2%
Pgm. 3	2.0%	1.9%	1.7%	1.8%	-6%	-17%
Pgm. 4	5.3%	4.0%	3.5%	3.1%	-23%	-33%
Pgm. 5	2.1%	2.1%	2.2%	1.9%	-6%	1%

Analyzing the full set of 68 programs showed that the PR model reduced the MdAPE by an average of 10% compared to the traditional learning curve model. The associated confidence interval had a lower bound of -19% and an upper bound of -1%. Note that the confidence interval did not contain zero, suggesting that there are differences between the models. Table 4 has these summary statistics for the MdAPE. An examination of the MAPE has similar results. The PR model reduced the average MAPE by 23% in comparison to the traditional learning curve model.

Table 4 MdAPE Differences

N	Mean	Std Dev	Lower CI	Upper CI
68	-10%	38%	-19%	-1%

Next statistical significance is discerned via the Wilcoxon Ranked Sign test. The null hypothesis is that there is no difference between the traditional and PR curve, while the alternative states a difference exists. An alpha of 0.05 is used. See Figure 2.

Test Mean

Hypothesized Value	0
Actual Estimate	-0.0991
DF	67
Std Dev	0.37869

	t Test	Signed-Rank
Test Statistic	-2.1583	-459.500
Prob > |t|	0.0345*	0.0042*
Prob > t	0.9828	0.9979
Prob < t	0.0172*	0.0021*
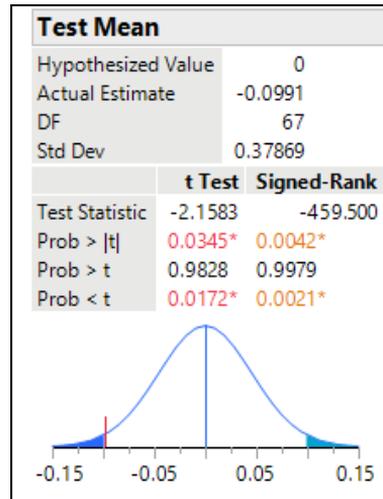
Fig. 2 Wilcoxon Test of MdAPE Differences

The two-tailed test returns a p-value of 0.0042. This result is well below the 0.05 threshold. The evidence suggests that there is a statistically significant difference between the PR and traditional models. Combining the results of the MdAPE analysis with the Wilcoxon results indicates that a PR effect is present in USAF military aircraft. Therefore, USAF cost analysts should consider employing a PR variable in their models.

4.2 The Acquisition Timeline

With the appropriateness of a PR model established, the next question is *when* in the acquisition timeline it is best utilized. This is determined by mapping the lot number where the PR model became preferred to the program's IOC date. IOC was chosen because it is a focal point in the acquisition process.

IOC is mapped in intervals of +/- 10%. This mapping process necessitated development of a mapping rule. If a program falls between the interval 0.01 and 4.99 it maps to the smaller interval (e.g. 24.68% is in the 20% interval); alternatively, a program between 5.00 and 9.99 maps to the larger interval (e.g. 25.10 is in the 30% interval).

The 68 programs from Table 1 comprised the initial dataset. However, several data issues arose. These included unavailable IOC dates and IOC dates that were outside the production window. After excluding programs with these issues, the final dataset consisted of 36 programs.

Figure 3 shows the resultant histogram from the mapping process. Recall that zero denotes the IOC data and the programs are binned in +/- 10% increments. Results show that the median PR value is ~20% after IOC, with a mean of 13.8% post IOC. The associated 95% confidence interval ranges from 2% to 26% past IOC.
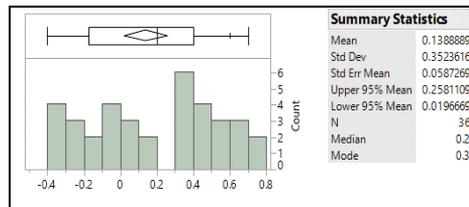

Fig. 3 Histogram of IOC%

Next a Wilcoxon Ranked Sign test is performed to determine if the PR occurs at IOC vice a point in time past (or before) IOC. An alpha of 0.05 is used. Figure 4 shows a p-value of 0.0285, which indicates there is a statically significant difference.
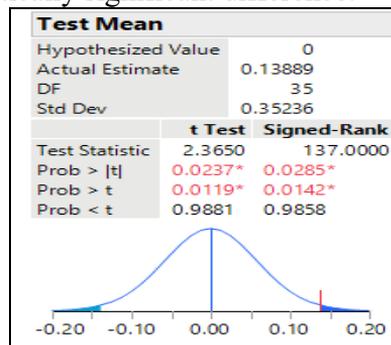

Fig. 4 Wilcoxon Ranked Sign Test of IOC%

The results from Figure 3 and 4 suggest that including a PR variable in the learning curve model should occur once the production process has ramped up and manufactured the initial quantity necessary to attain an IOC. To be conservative, defense cost analysts are cautioned that ~20% past IOC is where economies of scale are expected to be realized.

5. CONCLUSION

Learning curves are a core analytic method employed by defense cost analysts. They are ubiquitously recommended in defense cost estimating textbooks, manuals, guides, and best practices (Mislick and Nussbaum, 2015; Government Accountability Office, 2020; OSD-CAPE, 2022). Published support for modifying this core technique to include a PR variable that captures economies of scale has grown over time (Kunc et al., 2018; Government Accountability Office, 2020; OSD-CAPE, 2022). Yet previous empirical investigations into the efficacy of the PR modified model have been sporadic and are mired in small-scale datasets.

This paper sought to resolve the ambiguity regarding practical applicability of the PR model in military aircraft. Employing the largest known dataset to data, the results provide optimism that the PR model can be utilized. The analysis of 68 USAF military aircraft suggests the PR model is preferred to the traditional model. More specifically, the MdAPE error was reduced an average of 10% by utilizing the PR model. Due to the large production cost of military aircraft, the impact of a 10% deviation is not trivial. It often translates to millions of dollars per aircraft. These impacts pertain to the recurring flyaway cost level of analysis.

While the results are promising, caution is also advised due to several limitations. First, the dataset did not allow for analysis of different aircraft platform types. In other words, it could be that bombers, fighters, trainers, or cargo planes have unique characteristics that impact the generalized results. Second, there are likely to be unique, program specific effects that have impacts on recurring costs. These include contract specifications, tooling, or labor considerations and they should be deliberated upon prior to the decision to employ a PR model in favor of a traditional learning curve model. In other words, practitioners should take care to know their program first, and incorporate those unique characteristics in their estimating methodology. That caution is not unique to this analysis, rather it represents best practices in the cost estimating community.

In summary, ameliorating cost growth in defense programs is only achievable when cost estimators are equipped with the best available tools. The findings of this paper support guidance suggesting a PR variable is

important to consider when developing an aircraft learning curve model. Additionally, practitioners are advised to only employ the PR model post-IOC. These enhancements to current practices can lead to better informed decisions and improved resource allocation in the defense arena.

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THE EFFECTIVE APPLICATION OF STRATEGIC COMMUNICATION IN THE FIELD OF NATIONAL SECURITY

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The research is dedicated to "Strategic Communication" and its elements. Either core element of strategic communication is enlightened through study of literatures. As a showcase the Second Karabakh War between Azerbaijan and Armenia is reviewed and studied. The outcomes achieved in the conclusion of the research proves the essence and importance of strategic communication in victory.

Key words: *strategic communication, information operations, psychological operations, public affairs, national security*

1. INTRODUCTION

The effective application of Strategic Communication in the field of National Security is essential to achieving national security objectives. Several areas in the concept of general communication began to develop in the last two decades. In particular, at present, we come across acronyms such as Information Operations (IO) and Psychological Operations (PSYOPS) and Public Affairs (PA). The development of communication was carried out by allocating integrated communication technologies for use in implementing elements of the national strategy. Thus, the regular use of the terms IO, PSYOPS and PA in the field of national security began to popularize the concept of "strategic communication." For example, we can show the period after the terrorist attacks in the USA in 2001.[1]

2. THE ESSENCE OF STRATEGIC COMMUNICATION

The term "strategic communication" has become a trend in recent years. Before starting the main body of the topic, we must begin clarifying what we mean by

strategic communication. Strategic communication means synchronizing words and actions and how selected audiences will receive them. It also includes programs and activities to communicate and engage with a targeted audience. Strategic communications are essential for countering hostile narratives and engaging with the global community. Therefore, strategic communication is viewed as something that should be used to support national interests and be synchronized with national power. The majority of the country's political and public spheres have developed strategic communication. Every government organization has a unique method of strategic communication. As a result, its inappropriate application has become widespread and needs to be clarified. Strategic Communication is one of the main tools for pursuing and maintaining permanent national objectives for National Security. Regarding national security, strategic communication is a definitional draft devoid of any theoretical or methodological underpinnings and a logical practice entangled in a battleground of disciplines and professions that intend to adopt the idea in one way or another without considering the intellectual ramifications. Therefore, despite the mutilation of the lexicon, they need to recognize the

significance of the strategy concept and attempt to accommodate it. [2]

We can mention another widespread definition of strategic communication. The "capability" to disseminate messages in the quickest, most synchronized, transparent, and most effective way to reach the intended audience would be considered strategic communication. Strategic communication began in the economic sphere and has evolved into a phenomenon whose adaptability and applicability have been hotly debated in the current global security environment. [3]

Implementing strategic communications in national security is an integral part of the state's efforts to achieve political and defense objectives. Strategic communication efforts should reinforce key themes and messages and be constantly measured against defined objectives. As a result, adjustments must be made, and those responsible for implementation must be held accountable. Strategic communications efforts are an essential component of any country's national security. Strategic Communications play a vital role in winning in non-war contexts. Strategic communication is the primary means of action against dangers that can threaten the values and security of the state. Moreover, it can be used effectively against

external threats in modern times. The formation of the practical application of Strategic Communication in the field of National Security depends on the mutual study of its main principles and the experiences of its application in the Second Karabakh War.

3. THE PRINCIPLES OF STRATEGIC COMMUNICATION

The main principles of Strategic Communication help stakeholders of National Security to work together to identify, prevent, and respond to domestic and international security threats. Strategic communications combine actions, words, and images to achieve the desired effect. Visible leadership behavior and integrated actions and messages are essential to effective strategic communication. If we look at Strategic Communication, some concepts emerge. We can identify the most important ones and evaluate them as fundamental principles. National security is a complex and dynamic field involving many stakeholders, including government agencies, military personnel, law enforcement agencies, private companies, and civil society organizations. Effective strategic communication can play a vital role in achieving these goals by building relationships, promoting understanding, developing trust, managing crises, countering misinformation, and enhancing cooperation.

Firstly, building relationships with key stakeholders is a critical component of national security. Relationship-building with foreign governments, media outlets, and civil society organizations can benefit national security agencies from strategic communication. These connections can make it easier to work together to address common security issues like cyber security, counterintelligence or terrorism. Effective communication strategies can enhance trust and understanding among diverse stakeholders, reducing the risk of conflicts and misunderstandings.[4]

Next, promoting understanding is another important aspect of strategic communication in national security. Understanding different cultures, communities, and nations is vital to ensure that national security objectives are achievable. Strategic communication can help bridge knowledge gaps, promote understanding, and reduce misperceptions between different groups. [5] Strategic communication makes sure that the message is conveyed clearly to the intended audience while also being accurate and effective.

Thirdly, building trust is critical for national security. Strategic Communication can help national security agencies build trust with the public by providing accurate and transparent information, addressing

concerns, and responding to criticisms. Effective communication can nurture a relationship of trust and understanding between the stakeholders as well. In turn, this will allow for important security concerns to be shared openly and productively.

Then, managing crises effectively requires a coordinated response from national security stakeholders. Strategic Communication can be used to manage crises such as natural disasters, terrorist attacks, or cyber-attacks. Effective communication can provide accurate and timely information to the public, enhancing their understanding, reducing panic and confusion, and potentially saving lives.

The final principle, strategic communication, can assist in battling false and misleading information that could be used by enemies to erode national security objectives. In today's information age, misinformation and disinformation are major issues because various actors use them to spread harmful information.

Based on the principles, we can see the application of Strategic Communication in various areas of our environment. According to the US Army, conventional and nuclear kinetic capabilities are fundamental principles in strategic communications to influence the appropriate audience. [6] Because action, talk, and safety are all equally important. Strategic communication is one of the critical elements of the "coordinated deterrence" strategy adopted by the

United States in 2006 and is still used today.[7] Ensuring that the adversary fully and accurately understands your intentions and capabilities in the new global security environment is critical to use coercion strategies to influence an adversary's strategic decisions. As strategic communication is used in the security sector, discourse and action packages importance increases.

If we refer to the official NATO website, we can see that Strategic Communications includes many other elements. These include public diplomacy, political marketing, persuasion, international relations, military strategy, etc. can be cited as an example.[8] When we look at the traditional communication strategies of the first years of NATO's existence, it seems that it focused primarily on increasing awareness of the Soviet military threat by developing political discourses that would influence the public opinion of the member states against the Eastern Bloc.[9] Let's understand how NATO views the principles of strategic communication.[10]

a. Consistency in Action-Discourse Packages: An institution must consistently give the relevant public the most accurate and satisfactory information on any subject of interest. Additionally, the institution's actions and negotiations should always support one another during communication.

b. Integrity: entails harmony and communication between the tactical and strategic levels.

c. Rapid response: The organization must obtain the most accurate information quickly and without errors and bring it to the attention of the relevant public.

d. Transparency: An organization must be transparent in its intent, purpose, and, most importantly, in sharing information.

e. Strategic Leadership: Strategic communication is the element the organization's leader manages. Strategic leadership sets policies to shape the organization's official discourse.

f. A decentralized approach and initiative in Strategic Conversations: The defined strategic talks should be communicated to all institution employees, and everyone should have continuous, anywhere, anytime access to these discussions.

g. Continuity: The institution must stay in touch with the appropriate public. There shouldn't be any breaks in the flow of communication. At every opportunity, actions and speeches highlighting the organization's objectives should be shared with the public and supported by written, verbal, and visual materials.

h. Clarity: It is essential to be clear about the communication's goals and the desired outcome. Communication procedures without a purpose and unpredictable consequences must be avoided.

i. Creativity: To raise its "corporate awareness" in front of the relevant public, an organization must continuously follow innovations.

j. Ability to analyze: The organization should understand the communication environment and pertinent public opinion.

When these principles of NATO are examined, it can be said that the deception and counterintelligence operations conflict with the strategic communication concept, which is based on continuously, transparently, and accurately informing the relevant public. [11] For instance, the units in charge of information operations may want to show more or less the capabilities used in this exercise due to strategic objectives. In contrast, the Public Relations Office wants to share accurate information about any NATO exercise with the relevant public. In addition, military intelligence officers may be opposed to disclosing information on this subject to open sources as a principle of counterintelligence, even though the Public Relations Office strives to provide transparency by sharing as much information as possible with the related public.[12]

4. IMPLEMENTATION IN PRACTICE

In 2020, during the Second Karabakh war, Azerbaijan recaptures territory around Karabakh after six weeks of fighting and Armenian forces agreed to return to

Azerbaijan all occupied territory outside of the former Soviet Nagorno-Karabakh Autonomous Oblast [13].

In the Second Karabakh War, Azerbaijan used strategic communication to advance its national security interests presenting itself as the victim of Armenian aggression and depicting the conflict as a fight against terrorism, reiterating the United Nation's resolutions 822, 853, 874 and 884 [14]. Azerbaijan's strategic communication efforts were focused on shaping public perceptions, gaining international support, and controlling the narrative of the conflict.

Firstly, Azerbaijan used social media campaigns, official statements, and diplomatic efforts to present itself as a victim and counterbalance the Armenian allegations [15]. By highlighting the destruction and loss caused by Armenian forces in the conflict, Azerbaijan attempted to gain empathy and support from the international community. An active process of influence aimed at persuading the relevant public, taking into account people's current attitudes and behaviors, and measuring changes in those attitudes and behaviors is what communication is instead of a straightforward and one-way exchange of information.[16]

Azerbaijan implemented its strategic communication strategies in the field of war through information warfare groups. The Nation also used strategic communication to showcase its military successes and technological advancements, emphasizing its ability to defend its sovereignty and territorial Integrity. This approach served to boost national morale and demonstrate dominance on the battlefield, thereby advancing its national security interests.

Another significant strategic communication strategy was the increasingly sophisticated way Azerbaijan used its Israeli UAVs and Loitering Munitions (LMs). Those systems were not only used to strike, but real-time video from these weapons was used to fight an information warfare campaign via social media outlets, hoping to demoralize Armenian public support for their government. [17]

The high-definition videos produced by drones and used by Azerbaijani and Turkish information warfare teams had a dramatic effect on the domestic front of Armenia. Mothers closely scanned dozens of strike videos on social media, hoping their sons were not in one. Never before in the history of warfare has an information war campaign had such immediate and dramatic high-quality video footage. [18]

We consider this an example that supports the idea of complete

superiority of Azerbaijan's defense sector in Strategic Communication.

In terms of diplomatic and persuasion principles, during the Second Karabakh War, President Ilham Aliyev directed Azerbaijan's informational campaign and was interviewed by media organizations from various nations in four languages. More than 30 interviews with foreign media outlets, including the BBC [19], CNN [20], France24 [21], Sky, Al Jazeera, Fox TV, ARD, Le Figaro newspaper, TRT and RBC were conducted by the president. Through these interviews, President Aliyev represented Azerbaijan worldwide. Despite the bias of the global media, President Aliyev's interviews helped shift the dynamics of the information war in Azerbaijan's favor. [22]

Second, by suggesting the presence of foreign fighters, and mercenaries, among Armenian forces, Azerbaijan's strategic communication efforts sought to frame the conflict as a war against terrorism. Azerbaijan sought to gain international acceptance for its military actions and support for its efforts to combat the threat of terrorism by portraying the affiliation between the Armenian forces in Karabakh and global terrorist organizations. We can cite as an example the ongoing Russian-Ukrainian War, which brings together the international relations and military domains. The fallout from Russia's aggression in Ukraine hastened the development of Strategic Communication within NATO and has also drawn attention to the country's defense strategies. Moreover, it supports the idea that the North Atlantic Alliance shouldn't have been surprised at all about the unfolding of the events, because the Russian side had been talking about what they did for years. Media and social networking tools should be used in order to perform STATCOM assignments. [23]

In his book "The Art of War," the famous Chinese strategist Sun Tzu states that strategists win the battle before the War. However, in another chapter, he said that fighting or invading was not the highest professionalism in War and that he saw the perfection of fighting in breaking the enemy's will to fight. [24] The fact that the Armenian side was forced to turn over control over the Lachin region, and cities like Shushi, and Agdam in the aftermath of Second Karabakh War is a clear illustration of Sun Tzu's statements. [25]

5. CONCLUSION

The successful application of strategic communication is critical for national security during times of War. It helps to shape public perception, gain international support, and control the narrative of

the conflict. Strategic communication's practical application in the area of national security depends on the mutual study of its guiding principles and the lessons learned from its use during the Second Karabakh War.

In this conflict, Azerbaijan used strategic communication to its advantage, and the effectiveness of its communication strategies influenced the outcome of the conflict. Azerbaijan's national security strategy during the Second Karabakh War heavily relied on the use of strategic communication. By portraying itself as a victim of aggression and framing the conflict as a war against terrorism, Azerbaijan was able to advance its national security interests, control the narrative of the conflict, and win international support.

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STRATCOM vs PROPAGANDA AND THE IMPORTANCE OF KPIs FOR EFFECTIVE STRATEGIC COMMUNICATION

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Words are one of the simplest and most readily available instruments for influencing and educating the masses. Good communication always maximizes the likelihood of effectively attaining organizational objectives by creating understanding and support of the relevant audiences. However, communication effectiveness cannot be achieved unless clear objectives and appropriate KPIs are established. In this paper we shall try to discuss similarities and differences between propaganda and StratCom, as well as the importance of using the appropriate key performance indicators (KPIs) for a successful communication process.

Key words: StratCom, propaganda, communication, objective, audience, effectiveness, key performance indicators

1. INTRODUCTION

Human communication is an instinctual activity, an exchange of information with the purpose of carrying out daily activities, which happens without much analysis or preparation beforehand. However, there is also the reverse when it is a well-conceived, conscious and deliberate act especially, when it is done in support of something considered important. Unlike instinctual and spontaneous forms, refined forms of communication play a huge role in everyday life because words are one of the simplest and most readily available "weapons" for influencing and educating the masses, and good communication maximizes its effectiveness. The more effective the communication, the faster the (organizational) goals can be achieved, resulting in performance at all levels. Information brings power and influence, and the exchange of information cannot be achieved

without communication. It is one of the most important forms of interaction between an organization and its environment and it is also key to the success of the relationship between an organization and its audience, it is the means to mobilize, to enthuse the masses or to demoralize them. Political science experts and sociologists call this aspect of communication propaganda, words which are used to influence, to persuade masses towards one or another direction. In this paper we shall try to discuss whether propaganda is something inherently negative or not, the differences between propaganda and StratCom and the importance of identifying the appropriate key performance indicators (KPIs) in order to attain communicational effectiveness.

Propaganda is a concept with deep negative connotations. However, etymologically, the word propaganda does not contain such nuances, the noun is of Latin origin and it derives from the verb *propagare* which simply means to spread, to propagate. Therefore, what changed its aspect from neutral to positive or to negative and turned its inherent significance towards something negative is the nature of the actions performed by those propagating the information and the consequences described and associated with the actions and with

those orchestrating the communications. Frequently, entities standing at opposite ends and having antithetical interests will label each other's (strategic) communication as propaganda with the obvious purpose of discrediting the opposing side's communication.

When analyzing its connotations we should also take into considerations the fact that there is a difference between propaganda in the domain of foreign policy or advertising, and what happens during wartime and conflicts. According to Andrew Scott, propaganda in foreign policy is a polite way of engaging in political discourse with the purpose of achieving aims without resorting to war and its attendant ramifications [1].

2. PROPAGANDA

So, what is propaganda? Propaganda has been part of human social lives for centuries, even if it has not always been classified as propaganda. According to Encyclopedia Britannica, it is the "dissemination of information — facts, arguments, rumours, half-truths, or lies—to influence public opinion" [2]. This activity has been practiced by rulers, warriors, politicians, basically, people in power, and it can be traced back as far as we can find recorded history. For example, Arthashastra, the Indian Sanskrit Treaty, a work about statecraft written by multiple authors

between the 2nd and 3rd centuries BCE, approaches the topic of propaganda, but without naming it so [3]. The term was introduced in use with the printing of *Congregatio de Propaganda Fide* (Congregation for Propagation of the Faith), which is the product of an organization of Roman Catholic cardinals founded in 1622 to carry on missionary work [3]. Based on the book intended, the meaning of the word propaganda did not include lying or distorting the truth, it was just the idea of spreading the faith with some nuances of persuasion.

According to J. MacPherson of The New Shorter Oxford English Dictionary, the term acquired a political nuance in 1790 with reference to an obscure alleged revolutionary organisation based in France, reference that can be found in A. Aspinall "The correspondence of George, Prince of Wales, Volume II: 1789-1794", "All Kings have a new race of Pretenders to contend with, the disciples of the propaganda at Paris or, as they call themselves, Les Ambassadeurs de genre humain" [4]. It was also used in the United States as a slogan-word to refer to the pro-slavery campaign after the Mexican war in the 1850s [6]. Napoleon as well, relied heavily on propaganda to win his wars. According to P. Taylor, before 1914 it referred to the process by which "the converted attempted to

persuade the unconverted" [7]. The procedure was perfected during the First World War and all the conflicts that followed, and the concept got discredited even more and acquired a lot of negative nuances due to the common perception that it was used to cover the terrible things that were happening during the war [8].

Nowadays, based on the circumstances under which propaganda has been used for so many centuries, it can be defined as "statements or ideas that are often exaggerated or false, and are spread in order to help a leader, a cause, a government, etc." [9]. In other words, under the term of propaganda we encounter biased and often misleading information that is continuously and persistently served to a specific audience. Thus, the concept transformed from what it started as, a means of popularizing specific information, and started being perceived as including misinformation and disinformation. However, propaganda is not exclusively manipulative, it can also be positive if it is used to help people and promote positive change in the society. Positive propaganda can be utilized to stir up strong feelings of patriotism, as well as to mobilize people to collectively support good causes [10]. Unfortunately, when the limits of persuasion are pushed too much and get mixed with a lot of

disinformation the effects are nocive [11].

3. STRATCOM VS PROPAGANDA

Currently, governments and organizations have included communication on the list of essential organizational activities and have developed communication strategies. The new domain is named StratCom and it basically focusses on explaining and promoting the organizational or governmental, values, objectives, mission. Still and all, should official communication be only informative or should it also try to persuade, and how? The main purpose of effective communication is creating understanding and behavior change which quite frequently is actually a consequence of understanding a topic which is done through a lot of information and persuasion [12].

The UK Defence definition of StratCom sees all Defence's assets as potential tools of communication. The proposed definition is therefore now: advancing national interests by using Defence as a means of communication to influence the attitudes, beliefs and behaviours of audiences [13].

The USA used to have a different approach on strategic communication, considering it to be only about information while influence could be used only if it were part of an operational plan "information operations activities focused on influence and counter command [...] may only take place as part of an OPLAN [Operation Plan] and thus with NAC approval, including definition by the NAC of adversaries and potential adversaries" [14]. The situation changed after 2014 Russian invasion of Crimea when Russia used disinformation so much that it affected the the NATO countries so, NATO changed the informing approach to desired effects and "inform and influence audiences through actions and words" [15]. Communication became an instrument used to shape the environment with the aim of gaining support and changing behavior of the audiences. "The integration of communication capabilities and information staff function with other military activities, in order to understand and shape the information Environment (IE), in support of NATO aims and objectives." [16].

Communication is meant to be informative, but also persuasive, especially StratCom which is developed in support of organizational goals. Whatever an organization says or does, it is done with a purpose in view. Even if such communication respects the truthful and factual principles it is still

subjective in the sense that it needs to comply with and support the organizational objectives however, it will not propagate misleading or bended information.

Propaganda and Strategic Communication (StratCom) are two distinct concepts, although they both involve the use of communication to influence audiences. Here are the key differences between propaganda and StratCom:

Objectives: Propaganda typically aims to manipulate information and shape public opinion to advance a specific agenda or ideology. It often involves the deliberate dissemination of biased or misleading content. On the other hand, StratCom focuses on achieving specific objectives by building understanding, trust, and cooperation among target audiences. The goals of StratCom can include promoting public safety, fostering cooperation, managing crises, or enhancing an organization's reputation.

Ethical Considerations: Propaganda is often associated with the manipulation of information, distortion of facts, and the suppression of dissenting views. It can disregard ethical considerations, such as truthfulness, transparency, and respect for individual autonomy. StratCom, on the other hand, generally adheres to ethical standards, emphasizing honesty, accuracy, and a two-way dialogue with the target audience. StratCom aims to build credibility and maintain a positive reputation over the long term [17].

Audience Relationship: Propaganda often assumes a passive audience that is meant to be influenced or persuaded without active engagement. It tends to rely on one-way communication, where the propagandist controls the message. In contrast, StratCom recognizes the importance of engaging the target audience in a dialogue, building relationships, and fostering mutual understanding. StratCom encourages feedback, interaction, and the exchange of ideas between the communicator and the audience.

Transparency: Propaganda often operates covertly, disguising the true source of the information or the intentions behind it. It may employ deceptive tactics or use misinformation to achieve its objectives. StratCom, on the other hand, emphasizes transparency and open communication. It seeks to establish trust with the audience by providing accurate and reliable information, disclosing the communicator's identity and intentions, and being accountable for the messages conveyed.

Long-term Focus: Propaganda often focuses on short-term gains and immediate results, aiming to influence public opinion or behavior

in the short run. StratCom takes a more long-term perspective, aiming to build relationships, foster understanding, and achieve sustained cooperation over time. StratCom initiatives often involve ongoing communication efforts and maintaining consistent messaging to build trust and credibility.

4. EFFECTIVE KPIs

Propaganda, as well as StratCom, works only if the messages have been developed after a thorough analysis of the information environment, of the audience and of course, after identifying what communication objectives need to be attained. Effectiveness cannot happen without a good set of KPIs, which should be objective and measurable, and an established baseline [18], [19].

In order to assess the effectiveness of StratCom we need metrics and a baseline to start from. Key Performance Indicators (KPIs) for StratCom can help assess the effectiveness of communication efforts and their impact on achieving strategic goals. Here are some potential KPIs for StratCom:

Message penetration: Measuring the extent to which the intended messages are reaching the target audience through various channels, such as media coverage, social media engagement, website traffic, or email opens.

Audience perception: Surveys or sentiment analysis are necessary to determine whether there are changes and to what scale in the audience perceptions, attitudes, or understanding related to the organization's goals or values.

Behavior change: Assessing whether the StratCom initiatives have influenced desired behaviors or actions among the target audience, such as increased support, engagement, or compliance.

Engagement and interaction: Measurements of audience engagement and interaction with StratCom content, such as likes, comments, shares, or participation in events or discussions.

Reach and exposure: Evaluation of the extent to which the StratCom efforts have reached the target audience and expanded the organization's visibility or influence through metrics like reach, impressions, or media mentions.

Reputation and trust: Assessments of the organization's reputation and the levels of trust among the target audience through surveys, reputation indices, or feedback mechanisms.

Feedback and sentiment analysis: Analysis of feedback, comments, or sentiments expressed by the target audience to understand their perceptions, concerns, and needs,

and adjusting StratCom efforts accordingly.

Alignment with objectives: Continuously assess whether the StratCom initiatives are aligned with the organization's broader strategic goals and objectives.

Cost-effectiveness: Evaluation of the efficiency and cost-effectiveness of StratCom activities by measuring the return on investment (ROI) or comparing the cost of reaching the target audience with the achieved outcomes.

These KPIs should be customized according to the specific objectives, target audience, and context of the StratCom initiative. Regular monitoring and evaluation can help refine communication strategies, optimize resource allocation, and ensure that communication efforts are effectively contributing to the organization's goals [20], [21].

5. CONCLUSIONS

While there are differences between propaganda and StratCom, it's important to note that the boundaries can sometimes blur, and the intentions behind communication initiatives can vary in practice. The ethical use of communication to inform, engage, and build relationships is a fundamental principle of StratCom, distinguishing it from the manipulative nature often associated with propaganda. Strategic Communication refers to the planned and coordinated use of communication to achieve specific objectives in the context of an organization, government, or military. Unlike propaganda, which focuses on manipulating information for a specific agenda, StratCom aims to build understanding, trust, and cooperation among target audiences.

Nevertheless, for effective results we need appropriate KPIs to help assess the impact of communication efforts, identify areas for improvement, and demonstrate the value of communication in support of the organizational goals.

In summary, StratCom encompasses a broader and more neutral concept of communication planning and execution, often employed by military and political entities to achieve objectives through effective communication. On the other hand, propaganda is a narrower term that refers to the dissemination of biased or misleading information with the intent of manipulating public opinion and advancing a specific agenda, often through unethical means.

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BALANCING ECONOMIC DEVELOPMENT AND RESILIENCE: A POLICY PARADOX

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The aim of this paper is to explore the intricate relationship between sustainable economic development and economic resilience. It highlights how measures to stimulate economic growth, such as investments in physical and human capital, innovation, entrepreneurship, and sound fiscal policies, can also bolster resilience, while recognizing the potential conflicts between short-term growth and long-term resilience goals, especially in the context of increasing debt. The paper also proposes several mitigation strategies offering a roadmap for governments to strike a balance between fostering economic expansion and ensuring readiness to face unforeseen challenges, with the flexibility to adapt to unique economic contexts.

Key words: *resilience, economic, growth, mitigation, strategies, holistic approach*

1. INTRODUCTION

In the ever-evolving landscape of governance and policymaking, few challenges rival the delicate equilibrium required to balance the pursuit of robust economic development with the imperative to fortify a country's resilience. This conundrum is an issue faced in contemporary governance, as nation's worldwide grapple with the need to foster prosperity while safeguarding against the capricious tempests of an increasingly unpredictable world. This essay endeavors to delve into the intricacies of this policy paradox, probing the fundamental question: can economic development and resilience coexist harmoniously, or do they perennially find themselves at odds?

At the heart of this paradox is a fundamental tension between immediate, and often narrow, interests of economic growth and the broader, long-term objectives of resilience—safeguarding communities and institutions against myriad risks, from economic crises and environmental challenges to migration and conflicts. Economic

development beckons with the promise of higher living standards, new job opportunities, and the realization of societal aspirations, yet this pursuit can inadvertently engender vulnerabilities and dependencies that undermine the very progress it seeks to deliver. Conversely, resilience, while vital for enduring adversities and sustaining social structures, can sometimes stifle economic dynamism with its emphasis on prudence, risk mitigation, and the allocation of resources to contingencies rather than investments. The policy choices required to enhance resilience, often involving regulatory strictures and financial investments in infrastructure and preparedness, can appear to impede growth, provoking a persistent policy tension.

Throughout this article, we will explore the inherent dilemmas and trade-offs in balancing economic development and resilience. Drawing upon case studies and theoretical perspectives, we will illuminate the moments where these two policy objectives find themselves in conflict and uncover strategies for reconciling their differences, with the aim of providing valuable insights for policymakers and scholars navigating this complex terrain.

2. THE CONCEPTS OF ECONOMIC RESILIENCE AND ECONOMIC DEVELOPMENT – LITERATURE ANALYSIS

The concept of resilience is multifaceted and makes the object of studies in several domains, consequently the concept is approached in the literature from various perspectives, each offering a nuanced understanding of this complex concept. Resilience viewed from a broad, strategic level point of view refers to a nation's capacity to endure, recover from, and adapt to economic shocks, disruptions, and crises, holds a paramount role in safeguarding a country's national security and stability. NATO defines resilience as the ability to prepare for, withstand, respond to, and recover from shocks and disruptions, thereby ensuring continuity in the Alliance's activities (https://www.nato.int/cps/en/natohq/topics_132722.htm). The concept of resilience is not a new issue for the EU, as it was addressed from 2006 within the European Program for the Protection of Critical Infrastructure, but the concept of resilience was approached in a rather ambiguous manner, summarizing rather than adopting a holistic approach, focused initially on the social environment (Pernica, Tomášková

2016). Currently, the European Union delineates resilience as not only the capacity to withstand and manage challenges but also to undergo transitions in a sustainable, fair, and democratic manner, encompassing social and economic, geopolitical, green, and digital dimensions (Manca, Benczur, Gionannini, 2017).

Economic resilience is an important component of resilience at nation level and is usually analyzed from the perspective of an economy's ability to withstand economic shocks, recover and adapt to the various unforeseen disruptive events that can originate within or outside a nation's economy Dhawan and Jeske, p. 21–32). Other authors (Pendall *et al.,* 2009, p.71-84) consider economic resilience as the complex concept of adaptation and change in in an economic system to conditions generated by external shocks and factors.

Economic resilience is examined from a macroeconomic perspective concerning the economy's ability to cope, recover, and reconstruct, thereby minimizing aggregate consumption losses during crises (Hallegatte, 2014). From a combined microeconomic and macroeconomic standpoint, it considers how individual economic agents and the broader economy respond to shocks. (Pinkwart et all, 2022, p. 763–786).

3. RESILIENCE AND DEVELOPMENT: SHORT-TERM GAINS VS. LONG-TERM SUSTAINABILITY

Sustainable economic development and economic resilience are often interconnected, as the ability to resist, adapt and recover from shocks is the foundation for economic growth. *Measures aimed at stimulating investments in physical capital* (e.g., infrastructure, technology, machinery) and human capital (e.g., education and workforce training) can boost productivity and economic growth, but at the same time can support economic and social resilience.

Stimulating the advancements in innovation and technology can drive economic growth by improving efficiency, reducing costs, and creating new products and services, and at the same time ensure economic resilience by reducing a country's dependence on certain industries that are more exposed to shocks such as supply chain disruptions or fluctuations in prices or demand.

Entrepreneurship is another common area between economic growth and economic resilience, as a thriving entrepreneurial ecosystem encourages the creation of new businesses, which can lead to job creation and economic growth, but it

can also encourage economic resilience through competitiveness, diversification and adaptation.

Sound fiscal and monetary policies can stimulate growth, and on long term they can also contribute to resilience by promoting stability, predictability and lowering the vulnerability of the economy to external influences and shocks.

On the other hand, some measures aimed at achieving economic growth on short term can potentially come in conflict with long term measures aimed at achieving economic resilience.

An increase in the public or private debt may contribute to economic growth on short term, through stimulating demand and consumption, or through capital investments. When individuals or businesses take on debt, they may use the borrowed funds for spending on various goods and services. This increased spending can boost demand in the economy, leading to increased production and job creation. This is especially true in the case of consumer spending and business investments. Debt can be used to finance investments in productive assets, such as machinery, technology, infrastructure, or research and development. These investments can lead to increased productivity and economic growth, but an excessive debt level can also hinder economic

resilience in the event of a shock or crisis. During financial crises, public debt can be used to stabilize the financial system, support troubled industries, and provide social safety nets, preventing a further economic downturn. In times of economic downturns, central banks may implement low-interest rate policies to encourage borrowing, with the result of reduced cost of servicing debt, making it more attractive for individuals and businesses to take on debt to fund investments and spending.

On the other hand, increased public and private debt, if not managed prudently, can undermine economic resilience and lead to a range of negative consequences. High levels of debt require substantial interest payments, both for individuals and governments. These interest payments can divert resources away from other important priorities, such as public investments, social programs, and emergency responses and reduce the government's ability to react to economic crises or other unforeseen events.

Excessive public debt levels limit a government's ability to respond to economic shocks. When a crisis occurs, such as a recession or a natural disaster, governments may need to engage in deficit spending to stimulate the economy or provide relief. High existing debt levels can

constrain their ability to do so, as they risk pushing the debt-to-GDP ratio to unsustainable levels.

High public debt levels can lead to higher interest rates in financial markets. This, in turn, can crowd out private investment as the cost of borrowing for businesses and individuals rises. Reduced private investment can lead to slower economic growth and decreased economic resilience.

Excessive debt can lead to a downgrade in a country's credit rating, making it more expensive for the government to borrow in the future. Higher borrowing costs mean that more revenue is allocated to servicing the debt, further reducing the resources available for essential public services and crisis response.

High private debt levels can also pose a threat to financial stability. In times of economic stress, individuals and businesses may struggle to service their debts, leading to defaults and banking sector vulnerabilities, which can amplify economic shocks and hinder recovery.

When governments resort to excessive borrowing and central banks monetize debt by printing money, it can lead to inflation and currency depreciation. These economic consequences erode the purchasing power of citizens and undermine economic stability.

High levels of private debt can leave individuals financially vulnerable. Economic downturns or unexpected expenses can lead to financial distress, reducing consumer confidence and spending, which can be detrimental to economic resilience.

A history of high and rising debt levels can erode the government's credibility and its ability to manage fiscal policy effectively, reducing the confidence in the government's ability to handle economic crises, potentially leading to capital flight and economic instability.

Finally, high levels of debt can lead to social and political tensions, as citizens may question the allocation of resources and the fairness of austerity measures that are often implemented to address high debt levels. These tensions can undermine political stability and hinder the government's ability to respond to crises effectively.
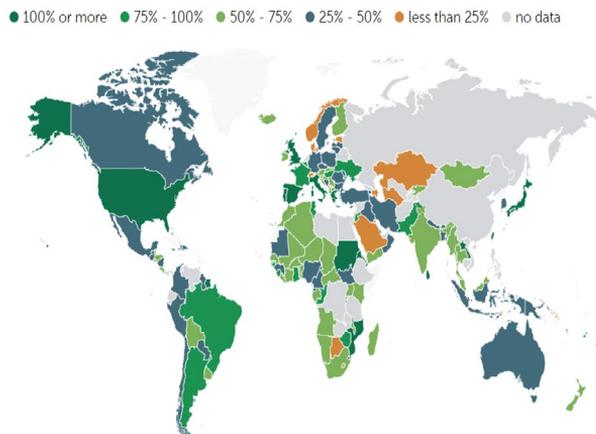
Fig. 1 Central Government Debt as Percent of GDP
Source:
https://www.imf.org/external/datamapper/CG_DEBT_GDP@GDD/CHN/FRA/DE
U/ITA/JPN/GBR/USA

Overreliance on a single economic sector is another factor that can undermine economic resilience, as economies overly dependent on one sector, such as oil or grain production, can be vulnerable to price fluctuations and global economic changes.

Overreliance on a single economic sector can initially contribute to short-term economic growth in that specific sector. This concentration of resources, labor, and investment can lead to increased production, exports, and profitability within that sector. As a result, it may create short-term economic growth, generate jobs, and boost government revenues. However, this growth is often unsustainable and can lead to economic instability in the long run. Over time, it can make the economy vulnerable to shocks specific to that sector, and if that sector

experiences a downturn or faces external pressures, it can lead to a rapid contraction of economic activity, causing short-term economic crises and setbacks. According to UNCTAD, "more than 60% of the world's small island developing states – on the front lines of the climate crisis – are commodity dependent and commodity-dependent developing countries make up a staggering 95% of the 20 countries most vulnerable to climate change, which amplifies their economic and social challenges"(https://unctad.org/news/commodity-dependence-5-things-you-need-know). Diversifying the economy is crucial to ensure sustained and balanced growth that is less susceptible to these short-term fluctuations and shocks.

Fig. 2 Global commodity dependence
Source: UNCTAD calculations, https://unctad.org/news/commodity-dependence-5-things-you-need-know

Stimulating consumption can contribute to short term economic growth, but at the same time *insufficient savings* at the individual and government levels can hinder resilience during economic downturns or emergencies. Robust financial safety nets, like unemployment benefits and social assistance programs, are vital.

High levels of income inequality can lead to social unrest and political instability, undermining economic resilience. Despite the fact that it is possible to achieve economic growth in conditions of high income inequality, the extent to which this growth benefits the broader population and the sustainability of such growth are important considerations to be analyzed. Inequality can stimulate economic growth only when it provides incentives for innovation, entrepreneurship, and investment.

Table 1 presents a comparison between the level of economic growth as compared to the previous year and the GINI coefficient, illustrating inequality levels, for the first 20 countries with the highest inequality.

Table 1 Economic growth and inequality

	GINI coefficient	Economic growth
South Africa	0.63	2.04
Namibia	0.59	4.56
Zambia	0.57	4.74
Colombia	0.54	7.5
Mozambique	0.54	4.15
Belize	0.53	12.13
Botswana	0.53	5.78
Angola	0.51	3.05
Saint Lucia	0.51	15.4
Panama	0.5	10.81
Zimbabwe	0.5	3.4
Brazil	0.49	2.9
Costa Rica	0.49	4.31
Guatemala	0.48	4.12
Honduras	0.48	4
Cameroon	0.47	3.54
Ecuador	0.47	2.95
Nicaragua	0.46	3.75
Chile	0.45	2.44

Source: https://www.theglobaleconomy.com for economic growth 2021 and World Bank for the GINI coefficient

Excessively high income inequality can hinder long-term growth by limiting access to education, healthcare, and economic opportunities for a significant portion of the population. It may lead to social unrest and political instability, which can disrupt economic activities. Furthermore, extremely skewed income distribution can reduce overall demand for goods and services, potentially hindering growth in the long run. Therefore, while growth is possible in unequal conditions, achieving sustainable and inclusive growth often requires policies and measures that address income inequality and ensure that the benefits of growth are more widely shared.

Expanding international trade can significantly contribute to economic growth in several ways. Firstly, it broadens market access for domestic producers, enabling them to sell their goods and services to a larger customer base, increasing sales and revenue. This, in turn, can

lead to the expansion of businesses and the creation of new jobs, reducing unemployment and boosting incomes. Secondly, increased trade often leads to enhanced specialization and efficiency, as countries can focus on producing goods and services in which they have a comparative advantage. This specialization improves productivity and lowers production costs. Additionally, international trade fosters competition, forcing firms to become more innovative and competitive, ultimately driving economic growth. Moreover, it allows for the inflow of foreign investment and technology, which can catalyze economic development. Finally, trade can also stimulate infrastructure development and investment in transportation and logistics, further supporting economic growth by facilitating the movement of goods and services across borders.

Despite its benefits, international trade can also undermine economic resilience in several ways. Firstly, heavy dependence on foreign markets for imports and exports can make an economy vulnerable to global economic fluctuations, such as recessions or trade disputes, leading to instability. Overreliance on international supply chains can disrupt essential goods and services during global crises, as was evident during the COVID-19 pandemic. Additionally, intense international competition can lead to job losses and wage stagnation, eroding the social safety net and increasing income inequality, which can weaken a country's social and economic stability. Furthermore, a focus on export-oriented industries might divert resources away from the development of diverse and self-sustaining domestic industries, leaving the economy susceptible to external shocks. Lastly, international trade can sometimes result in environmental degradation as industries prioritize cost-cutting over sustainable practices, which can ultimately undermine a nation's ecological resilience.

4. MITIGATION STRATEGIES

In order to de-conflict economic growth and economic resilience objectives and measures, it is of prime importance for governments to achieve a balance between fostering economic expansion and ensuring that economies can withstand shocks and disruptions, between short term and long term considerations. Some of the mitigation strategies recommended in this respect are outline below:

- Diversification of economic activities through encouraging diversification of economic sectors to reduce dependence on a single

industry, promoting innovation and technological advancements to enable new sectors to emerge and supporting entrepreneurship and small and medium-sized enterprises (SMEs) to increase economic flexibility.

-Strengthening infrastructure by investing in resilient infrastructure, including transportation, energy, and communication networks, to ensure rapid recovery from disasters, upgrading and maintaining critical infrastructure to minimize vulnerabilities and ensure long-term growth.

-Fiscal responsibility by implementing responsible fiscal policies that balance short-term spending for stimulus with long-term fiscal sustainability, maintaining fiscal buffers for times of economic downturns, ensuring the ability to invest in recovery.

-Financial system stability through regulating the financial sector to prevent excessive risk-taking and speculative activities, strengthening banking and financial institutions to withstand economic shocks.

-Social safety nets are an important part of societal resilience that underlines also economic resilience, so establishing comprehensive social safety nets to protect vulnerable populations during economic downturns should be one of the priority measures.

-Investing in education and skills development to enhance workforce adaptability.

-Risk assessment and management through conducting regular risk assessments to identify potential threats to economic growth and resilience, developing risk management strategies, including contingency plans and insurance mechanisms.

-Environmental sustainability by promoting sustainable practices to mitigate environmental risks, including climate change, investing in clean energy and resource-efficient technologies to enhance long-term economic resilience.

-Collaborating with international partners to address global economic challenges and participate in international trade agreements and organizations to foster economic growth is important, as national resilience should not be viewed in isolation in today's interconnected and globalized world.

-Government capacity building by strengthening government institutions to enhance their capacity to respond to economic crises effectively and ensuring transparency and accountability in public financial management.

-Public-private partnerships through fostering collaboration between government and the private sector to drive economic growth while managing risks jointly, encourage corporate responsibility and ethical business practices.

-Investing in research and development to drive innovation and

improve economic productivity and promote the adoption of digital technologies to enhance economic competitiveness.

-Data and analytics though implementation of data-driven decision-making to monitor economic trends and identify potential vulnerabilities and the development early warning systems to detect emerging risks.

-Resilience planning through development comprehensive economic resilience plans that encompass various sectors and address potential disruptions, and establish dedicated agencies or teams responsible for resilience planning and implementation.

-Public engagement and education by engaging the public in understanding the importance of economic resilience and the need for responsible economic growth, emphasize economic, financial and digital education at the level of the whole population, promote a culture of preparedness and adaptation to changing economic conditions.

-Appropriate regulations aimed at achieving the optimum balance between implementing flexible regulatory frameworks that can adapt to changing economic dynamics, while ensuring necessary oversight and control and the stability and predictability of the regulatory framework.

-Scenario analysis is a useful tool for ensuring resilience, by conducting scenario analysis to assess the impact of various shocks on the economy, allowing for more effective planning and mitigation.

-Long-term planning in order to encourage long-term thinking in policy formulation and investment decisions, rather than focusing solely on short-term gains.

These mitigation strategies can help strike a balance between economic growth and economic resilience, ensuring that countries can prosper while being prepared to withstand unexpected challenges and disruptions. The specific strategies implemented will of course vary based on a country's unique economic context and challenges.

5. CONCLUSIONS

Sustainable economic development and economic resilience are closely intertwined, with the ability to withstand and recover from shocks forming the foundation for lasting economic growth. While measures promoting investments in physical and human capital, innovation, entrepreneurship, and sound fiscal policies can stimulate economic growth, they also support economic and social resilience. However, an excessive reliance on short-term strategies, such as increasing public or private debt, can potentially conflict with long-term resilience goals, as high debt levels can hinder a country's ability to respond to economic shocks. Additionally, overdependence on a

single economic sector and high income inequality can undermine economic resilience and stability. Mitigation strategies to strike a balance between growth and resilience should be tailored to each country's unique circumstances, allowing nations to thrive while being prepared for unexpected challenges and disruptions.

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DESIGNING MILITARY ENGINEERING TRAINING BASED ON THE MODEL OF DIDACTIC JUSTIFICATION

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In today's dynamic and complex military landscape, the effectiveness of military engineering training plays a crucial role in preparing personnel for various operational scenarios. However, the lack of a structured and validated model for designing and justifying the didactic aspects of such training hinders its efficiency and outcomes. This article seeks to bridge this gap by providing a systematic approach to designing military engineering training programs. The aim of the article is to identify the main components required to develop a comprehensive Model of Didactic Justification for the Design of Military Engineering Training, addressing the challenge of optimizing the instructional framework in military engineering education. The model of didactic justification of the design of military engineering training is a conceptual framework that aims to provide a structured approach to designing and implementing effective training programs for military engineers. The model takes into account various factors that influence the design of military engineering training, including the specific needs of the military organization, the objectives of the training, and the characteristics of the learners. The model is based on a set of principles and guidelines that have been developed through research and practical experience in the field of military engineering training. These principles include the need for a clear understanding of the objectives of the training, the importance of selecting appropriate teaching methods and materials, and the need for ongoing evaluation and feedback to ensure that the training is meeting its intended objectives. The model will enhance the training's efficiency, effectiveness, and adaptability by incorporating pedagogical principles, military engineering expertise, and instructional technology advancements. Ultimately, the article aims to contribute to the improvement of military engineering training, resulting in better-prepared personnel and more successful military operations.

Research Problem Statement: The research aims to develop a comprehensive Model of Didactic Justification for the Design of Military Engineering Training, addressing the challenge of optimizing the instructional framework in military engineering education.

Research Relevance: In today's dynamic and complex military landscape, the effectiveness of military engineering training plays a crucial role in preparing personnel for various operational scenarios. However, the lack of a structured and validated model for designing and justifying the didactic aspects of such training hinders its efficiency and outcomes. This research seeks to bridge this gap by providing a systematic approach to designing military engineering training programs.

Research Purpose: The purpose of this research is to create a Model of Didactic Justification that offers a systematic framework for the design and evaluation of military engineering training. This model will enhance the training's efficiency, effectiveness, and adaptability by incorporating pedagogical principles, military engineering expertise, and instructional technology advancements. Ultimately, the research aims to contribute to the improvement of military engineering training, resulting in better-prepared personnel and more successful military operations.

In order to apply the model, designers of military engineering training must first conduct a needs assessment to determine the specific needs of the military organization and the learners.

Key words*: military, engineering training, objectives, learners, principles, guidelines, research*

1. INTRODUCTION

Military engineering plays a critical role in modern armed forces, encompassing a diverse range of tasks that demand both technical proficiency and strategic acumen. Effective training of military engineers is paramount to ensure their ability to navigate intricate operational landscapes and contribute to mission success. The design of training programs for military engineers requires careful consideration of pedagogical principles and the unique challenges presented by the field. In this context, the development of a robust model for the didactic justification of training design becomes imperative. Educational design theories have long been applied to civilian educational contexts to optimize learning outcomes and enhance instructional methods [1]. However, when it comes to military engineering training, a distinct blend of academic rigor and practical application is essential. The evolving nature of military operations demands engineers who are not only well-versed in theoretical concepts but also adept at applying their knowledge

in real-world scenarios. To bridge this gap between theoretical learning and practical execution, a model that integrates didactic principles with military engineering expertise is proposed. This model is designed to provide a structured framework that aligns learning objectives, instructional strategies, and assessment techniques. By merging pedagogical insights with the unique demands of military engineering, the model seeks to enhance the overall effectiveness of training programs and ensure that graduates possess both the cognitive understanding and hands-on skills required for success in their roles.

In this paper, we present the development and components of the proposed Model of Didactic Justification of the Design of Military Engineering Training. By considering the distinctive requirements of military engineering education, we aim to contribute to the ongoing enhancement of training methodologies within this vital field.

Furthermore, the dynamic and rapidly evolving nature of military technology and tactics adds another layer of complexity to the training of military engineers. New challenges arise as advances in technology reshape the nature of warfare, necessitating engineers to not only possess a deep understanding of traditional principles but also the ability to adapt swiftly to novel situations. The traditional pedagogical approaches alone may not suffice in

preparing engineers to handle the multifaceted demands of modern military operations. In this context, the proposed model draws inspiration from constructivist learning theories that emphasize active engagement and experiential learning [2]. By providing opportunities for learners to grapple with authentic problems and participate in realistic simulations, the model aims to foster the development of critical thinking, decision-making skills, and the capacity to innovate-traits that are indispensable in military engineering contexts [3]. The integration of didactic principles with military engineering expertise is crucial to ensure that training programs remain relevant and impactful. As military engineers are tasked with tasks that have direct consequences for operational success and safety, their training must go beyond theoretical understanding and encompass the application of knowledge in high-pressure scenarios [4]. Therefore, the proposed model seeks to bridge the gap between theory and practice, aligning instructional strategies with the exigencies of military engineering tasks. In the subsequent sections of this paper, we will delve into the key components of the Model of Didactic Justification of the Design of Military Engineering Training, exploring how it addresses the unique challenges faced by military educators and engineers alike. By addressing the convergence of educational theory and military exigencies, this model aims to

contribute significantly to the development of well-prepared, adaptable, and skilled military engineers.

2. PEDAGOGICAL PRINCIPLES AND PRACTICES

Pedagogical principles and practices play a pivotal role in shaping effective military engineering training programs. By incorporating evidence-based instructional strategies, educators can optimize the learning experience for military engineers and equip them with the necessary skills to excel in their roles. In this model, the integration of active learning strategies serves as a cornerstone [5]. Military engineering training benefits from approaches such as problem-based learning, where learners grapple with real-world challenges and devise solutions collaboratively. Such techniques foster critical thinking, encourage teamwork, and promote the application of theoretical knowledge in practical scenarios. Moreover, the alignment of learning objectives with Bloom's taxonomy is imperative [6]. Military engineers need to not only comprehend concepts but also demonstrate mastery through analysis, synthesis, and evaluation. This ensures that the training design addresses cognitive depth and complexity, enabling engineers to tackle multifaceted challenges. Additionally, the model emphasizes formative assessment techniques to provide continuous feedback and guide learners' progress. Given the high-stakes nature of military engineering tasks, timely feedback enhances learners' understanding and performance. Incorporating authentic assessments, such as realistic simulations and scenario-based evaluations, reinforces the application of knowledge in contexts that mirror operational environments. By amalgamating these pedagogical principles with the unique demands of military engineering, the model paves the way for a comprehensive approach to training program design. The subsequent sections of this paper will delve into the specific components and strategies encompassed by the Model of Didactic Justification of the Design of Military Engineering Training, offering insights into its practical application within military education contexts.

3. DESIGNING MILITARY ENGINEERING TRAINING

Designing military engineering training involves several steps that help to ensure that the training program is tailored to the specific needs and characteristics of the military organization and its personnel. Here are some of the key steps involved in designing military engineering training:

Needs assessment: The first step in designing military engineering training is to conduct thorough needs assessment. This involves gathering

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information about the specific needs of the military organization and its personnel, including the skills and knowledge required for their roles, the challenges they are likely to encounter, and any other relevant factors [7].

Learning objectives: Based on the needs assessment, specific learning objectives should be identified for the training program. These objectives should outline the knowledge, skills, and competencies that the learners are expected to acquire through the training program.

Selecting teaching methods and materials: Once the learning objectives have been identified, appropriate teaching methods and materials should be selected. This may involve the use of a variety of methods, including classroom instruction, hands-on activities, simulations, and other experiential learning methods.

Developing training materials: In some cases, it may be necessary to develop customized training materials, such as training manuals, handouts, or instructional videos, to support the selected teaching methods.

Implementing the training program: The training program should be implemented according to the identified learning objectives and the selected teaching methods and materials. This may involve the use of various instructional technologies and resources, as well as the involvement of trainers or instructors.

Ongoing evaluation and feedback: Throughout the training program, ongoing evaluation and feedback should be conducted to ensure that it is meeting its intended objectives and that the learners are acquiring the required knowledge and skills. This may involve the use of various assessment tools and techniques, such as performance evaluations, learner feedback, and follow-up surveys [7].

By following these steps, trainers can ensure that the military engineering training program is designed to meet the specific needs of the military organization and its personnel, and that it is effective in preparing learners for the challenges of their.

In addition to the steps mentioned above, there are some other important considerations that should be taken into account when designing military engineering training. These considerations include [8].

Learning styles and preferences: Military personnel may have different learning styles and preferences, depending on their backgrounds and experiences. Designing training that is sensitive to these differences can help to ensure that learners are engaged and motivated, which can lead to better learning outcomes.

Time constraints: Military personnel often have busy schedules and may not have a lot of time available for training. Designing training that is flexible and can be completed in shorter timeframes can help to ensure that learners are able to

complete the training and acquire the necessary knowledge and skills.

Technology: Advances in technology are constantly changing the nature of military engineering work, and training programs must be updated to keep pace with these changes. This may involve the use of new instructional technologies, such as virtual reality and simulation tools, to provide more realistic and effective training experiences.

Leadership and teamwork: Military engineering work often requires close collaboration with other military personnel, and effective leadership and teamwork are essential for success in this field. Accordingly, military engineering training should include instruction and practice in leadership and teamwork skills, as well as opportunities to work in teams on engineering projects.

By taking into account these considerations, trainers can ensure that the military engineering training program is designed to meet the specific needs of the military organization and its personnel, and that it is effective in preparing learners for the challenges of their roles. Additionally, trainers should ensure that the training program is regularly updated to remain relevant to changing military needs and requirements.

Selecting appropriate teaching methods is an important aspect of the model of didactic justification of the design of military engineering training. By selecting appropriate teaching methods, trainers can ensure that the training program is engaging, motivating, and effective in preparing learners for the challenges of their roles. In this research, we will explore some key factors that should be taken into account when selecting teaching methods for military engineering training.

One of the key factors to consider when selecting teaching methods is the specific learning objectives that have been identified for the training program. Different teaching methods may be more effective for different types of learning objectives. For example, if the learning objective is to develop hands-on skills related to military engineering, then hands-on training methods may be more effective than classroom instruction alone. Conversely, if the learning objective is to develop knowledge of military engineering principles and concepts, then classroom instruction may be more effective [7].

Another important factor to consider is the learning preferences and styles of the learners. As noted earlier, military personnel may have different learning styles and preferences, and trainers should take these into account when selecting teaching methods. For example, some learners may prefer visual learning, while others may prefer more hands-on, experiential learning. By selecting teaching methods that are tailored to the individual learning preferences and styles of the learners, trainers can

help to ensure that the training program is engaging and effective [8].

The context in which the training is being delivered is another important factor to consider when selecting teaching methods. Military engineering training may be delivered in a variety of contexts, including in the field, in a classroom setting, or through e-learning platforms. The context in which the training is being delivered may impact the effectiveness of different teaching methods. For example, hands-on training methods may be more effective in the field, while classroom instruction may be more effective in a classroom setting.

The resources that are available for the training program is another important factor to consider when selecting teaching methods. Different teaching methods may require different resources, such as specialized equipment, materials, or technology. Trainers should take into account the resources that are available for the training program when selecting teaching methods, and should select methods that can be implemented with the available resources [9].

In conclusion, selecting appropriate teaching methods is an important aspect of the model of didactic justification of the design of military engineering training. By taking into account factors such as the specific learning objectives, the learning preferences and styles of the learners, the context in which the training is being delivered, and the resources that are available, trainers can ensure that the training program is engaging, motivating, and effective in preparing learners for the challenges of their roles.

4. CHOOSING APPROPRIATE TRAINING MATERIALS

The model of didactic justification of the design of military engineering training is a framework for designing and developing effective training materials for military engineers. The model consists of several key components that are essential for designing high-quality training materials that meet the needs of military engineers.

One important component of the model is the identification of learning objectives. Before designing any training materials, it is essential to identify the specific knowledge, skills, and abilities that military engineers need to acquire. These learning objectives should be based on a thorough analysis of the job requirements and the needs of the target [7].

Another important component of the model is the selection of appropriate training materials. The training materials should be carefully selected to ensure that they are relevant to the learning objectives and the needs of the target audience. This may involve selecting existing materials, adapting existing materials,

or creating new materials from scratch.

In addition to selecting appropriate training materials, the model also emphasizes the importance of incorporating active learning strategies into the design of the training materials. Active learning strategies such as problem-based learning, case-based learning, and simulations can help military engineers apply their knowledge and skills in real-world scenarios.

Finally, the model emphasizes the importance of evaluating the effectiveness of the training materials. Evaluation should be an ongoing process that involves assessing the effectiveness of the training materials in achieving the learning objectives and identifying areas for improvement.

By using these references and incorporating the key components of the didactic justification model into the design of military engineering training materials, trainers and educators can ensure that military engineers receive high-quality training that prepares them for the challenges they will face in the field.

5. IMPLEMENTING THE TRAINING PROGRAM

Once the training materials have been designed, it is essential to implement the training program effectively. Implementing the training program involves delivering the training materials to the target audience and monitoring their progress throughout the training process. There are several key strategies that can be used to implement the training program effectively.

First, it is important to ensure that the training program is delivered in a way that is accessible to the target audience. This may involve delivering the training in multiple formats, such as in-person instruction, online modules, or interactive simulations. The training program should also be delivered in a way that is convenient for the target audience, taking into account their schedules and other commitments.

Second, it is important to provide support and guidance to the target audience throughout the training process. This may involve assigning mentors or coaches to help learners with the training materials, providing regular feedback on their progress, and offering additional resources or support as needed

Third, it is important to evaluate the effectiveness of the training program as it is being implemented. This may involve conducting formative evaluations to gather feedback from learners and trainers, as well as summative evaluations to assess the overall effectiveness of the training program.

Finally, one of the main goals of the training of officers is to cultivate certain military-professional and moral-voluntary qualities in officers, which will enable them to make

scientifically based decisions both in peacetime and in wartime, to overcome the difficulties of military service, and to defend the interests of the motherland he must ensure that they are ready to fulfill it as the highest and most honorable duty [10].

6. CONCLUSION

In conclusion, the model of didactic justification of the design of military engineering training is a framework that provides guidance on designing effective training materials for military engineers. The model emphasizes the importance of identifying learning objectives, selecting appropriate training materials, incorporating active learning strategies, and evaluating the effectiveness of the training program. Implementing the training program involves delivering the training materials to the target audience in a way that is accessible and convenient, providing support and guidance throughout the training process, and evaluating the effectiveness of the training program.

By following the key components of the didactic justification model and consulting the relevant references, trainers and educators can ensure that military engineers receive high-quality training that prepares them for the challenges they will face in the field. Effective training programs can help to enhance the capabilities of military engineers and ultimately contribute to the success of military operations.

Effective training programs can also contribute to the safety of military personnel by ensuring that they are well-prepared to handle potentially hazardous situations. In addition, effective training programs can help to reduce costs and improve efficiency by ensuring that military engineers have the knowledge and skills needed to complete their tasks effectively and efficiently.

It is important to note that designing and implementing effective training programs is an ongoing process. Trainers and educators should continually evaluate the effectiveness of the training program and make adjustments as needed to ensure that it remains relevant and effective over time. By doing so, trainers and educators can ensure that military engineers are equipped with the knowledge, skills, and abilities they need to succeed in their roles, both now and in the future.

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DETECTION OF EXTERNAL INTERVENTIONS IN THE INTERNET OF THINGS

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The importance of ensuring the security of Internet of Things (IoT) devices is just as crucial as accelerating the implementation process of IoT. Like other devices, IoT devices can be vulnerable to various types of attacks over the internet. To identify these attacks, attention should be paid to the system itself and the activity sequence of certain resources. This article discusses various types of security solutions for IoT devices. Additionally, a new solution is proposed to identify the potential impact of IoT devices. The experiments conducted using a Mikrotik router as a gateway have shown that it is possible to detect cyber attacks by monitoring the device's internal resources for various activities. Login attempts using different usernames recorded in the router's logs and the processor's jump activity were monitored to identify metrics indicating potential attacks based on increased sequential jumps. An algorithm was developed using these metrics, and a program was written in Python to detect cyber attack threats against the device.

Key words: IoT, gateway, attack, security

1. INTRODUCTION

The Internet of Things (IoT) refers to the management of everyday devices through various applications over the internet. As a result of connecting our daily-use items and household appliances to the global network, the terminology of the Internet of Things emerged. IoT is one of the fastest spreading and most current innovations in the world. This technology covers many application areas such as the automation of homes and various industrial fields, monitoring the environment, healthcare, etc. The expansion of this technology brings with it the benefit of easy access to the internet for everyone, as well as the use of limited numbers of special networks [1]. The main principle of IoT is to collect sensor data and transmit it to data centers over the internet. That is why special attention must be paid to security issues related to the Internet of Things.

By using global networks it is possible to transmit and receive information through devices over the internet. Many problems arise

regarding both control and management during the implementation of these processes. Several proposals have been made in various articles regarding these problems. Javier Carrillo-Mondejar and others [4] propose a module that checks the system for malicious software that has entered, configuration files, and symbols associated with them. With this module, it is possible to determine whether there have been any changes in symbols or files. Using this method, it is possible to detect the entry of malicious software into the system by comparing the current files with the original files. However, changes found in files using this module can result in the system being reverted back to its original configuration or reconfigured. This can cause the system to remain offline for a certain period during the recovery process. Additionally, if there is a delay during the comparison of files, the original files may also be damaged.

The volume of data generated by Internet of Things devices is significant. Big data and machine learning tools are used to analyze, protect, and manage this data. To facilitate these processes, prominent data centers have been established in various locations around the world. Examples of such data centers include Microsoft, Google, Amazon, and others. The architecture of the

Internet of Internet of Things (IoT) devices generate a large volume of data, which requires the use of big data and machine learning tools to analyze, protect, and manage them. To accomplish this, data centers have been established in various parts of the world, such as Microsoft, Google, Amazon, etc., to ensure the security and storage of such data. The architecture of IoT consists of a large number of devices and various communication technologies that ensure the connection of these devices to provide services required by end-users. Users can manage their own information and household items by obtaining this information from data centers through special applications. Umar Ahsan and Abdul Bais [5] have divided the architecture of IoT into several layers. According to their research, each layer must be protected by different security protocols. The increasing amount of data collected by sensors and its storage in big data databases in upper layers emphasizes the need for implementing specific security protocols for each layer. It should be noted that many traditional security protocols, which were once considered secure, have lost their relevance and reliability. Therefore, currently reliable security protocols and encryption methods may become outdated in the future. Considering that encryption methods are applied between devices and data centers

when transmitting data, it can be concluded that implementing security measures in the latest technology and data centers is more appropriate.

The Internet of Things technology also finds its application in critical infrastructures. For instance, the automation of smart cities, smart villages, smart power grids, etc. utilizes the devices of the Internet of Things. Majid Moazzami, Mahdi Shaneh, and others [2] have discussed the concept of smart grids, especially smart power grids, and the existing security problems. Their proposed solution helps to reduce the risks that jeopardize the security of devices used in critical infrastructures. One of the systems proposed in the article is the immunology system, which can detect dangerous threats and pass them through filters. According to their idea, during a threat, this system can identify viruses in secure locations in advance. However, the crucial issue is that even a short time interval between the virus's entry into the system and its discovery can cause serious risks. There may be some movement during this interval, which can harm the system. Identifying and preventing viruses or other threats before they enter the system should be one of the main goals.

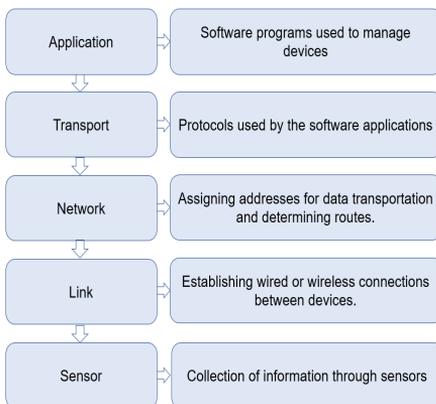This article proposes possible solutions to prevent the harmful effects of the Internet of Things and attempts to prevent the interception of information.

2. INTERNET OF THINGS (IoT) NETWORK

The article examines the network of the Internet of Things and the gateway device that provides internet access to the devices connected to this network. Various examples have been taken from the experiment conducted on the device. As a result of these examples, the self-execution of some resources related to the structure of the Internet of Things during attacks has been discussed.

The Internet of Things devices mainly collect information through sensors. For example, security cameras capture images through motion sensors and transmit them to the central information system, and the heating or cooling system is regulated based on the information obtained by the temperature sensor about the condition of the room. The transmission and reception of information occurs over the network. It should be noted that these devices create connections with each other and share information through wired or wireless interfaces. Different types of cables are used to connect wired interfaces with each other. Short-

range radio waves are used for connecting wireless interfaces. This is one of the main factors for physically connecting devices to each other and exchanging information. Of course, it is necessary to use any software to create these connections. Through these programs, we can both configure and monitor devices. Based on all this information, the structure of the Internet of Things technology can be shown with the following (Figure 1) layers.


Application	Software programs used to manage devices
Transport	Protocols used by the software applications
Network	Assigning addresses for data transportation and determining routes.
Link	Establishing wired or wireless connections between devices.
Sensor	Collection of information through sensors

Fig. 1 Layers of Internet of Things network

3. THE REASON FOR BEING VULNERABLE TO ATTACKS IN THE INTERNET OF THINGS NETWORKS

When observing the integration methods and connections between devices, it can be seen that the devices are connected to the internet only through gateways. Internet gateways are used to transmit the collected data from devices to the global network. Each device's local connection with gateways implies that they have at least one IP (Internet Protocol) address. Based on the topology shown in Figure 2, it should be noted that gateways play a fundamental role for each device used in smart solutions.
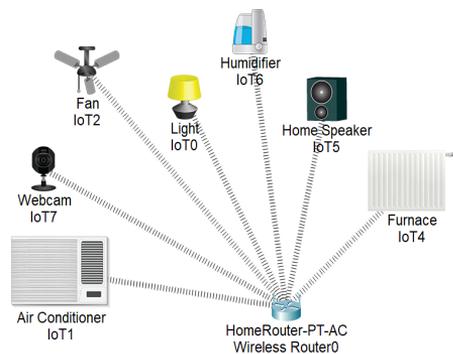
Fig.2 IoT connectivity scheme

From this, it can be seen that the main role of gateways is to transmit collected data over the internet or to gain access to devices over the internet. Therefore, it is possible to access and manage devices through gateways. For this reason, it is essential to control and monitor the external inputs of gateways.

Huichen Lin and Neil W. Bergmann have identified various vulnerabilities in security cameras through device search systems [3]. They have determined these

vulnerabilities by gaining access to security cameras through conventional protocols. To prevent such vulnerabilities, they emphasize the need for security measures to be taken for each layer of the Internet of Things architecture. They have also included a gateway architecture in their proposed architecture, especially highlighting the centralization of device registration and access through gateways. In the article, the gateway is not only considered as a means of establishing a connection between things and the internet, but also as a protective device. To act as a protective device, conventional secure protocols should be used through gateways. While it is possible to protect the network using these protocols, in some cases, attacks can still damage devices. The main purpose of the research in this article is to prevent successful or unsuccessful attempts to harm devices.

4. STATEMENT OF THE PROBLEM AND PROPOSED SOLUTION

As a result, the issue of detecting cyberattacks against the system based on the evaluation of the current activities of the Internet of Things has been raised. For simplicity, let's consider the issue in the context of a single object. Since the principles of operation of the Internet of Things are the same, the approach below can also be applied to the establishment of a protection system against cyber attacks for other objects.

Let's consider the Wi-Fi router, which is the main device responsible for connecting smart home devices to the internet, and plays the role of a gateway in the architecture of the connected home. We will take the Mikrotik router as an experimental object. The configuration, processor, and logs of the Mikrotik router have been analyzed.

For this purpose, let's first look at the performance indicators of the router during normal operation. As a rule, various jumps are observed at different time intervals on the graphics display of the router's processor. The jumps can increase or decrease depending on the traffic load, and such cases are evaluated as normal. Thus, the jumps observed with such sudden increases and decreases in the system's traffic load are considered normal activity according to the standard regulation and are not related to the device being under attack. Figure 3 shows

the processor indicators of the router during normal traffic load. It would be appropriate to rank and explain them over time.
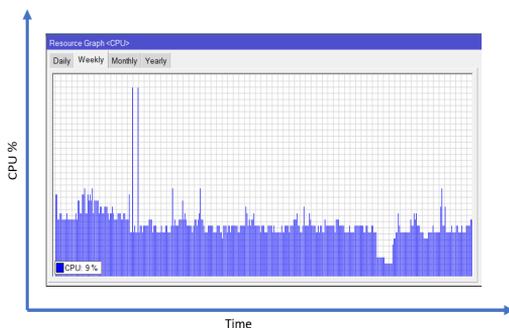
Fig. 3 Mikrotik Router Processor Metric

During the analysis of the log files, the observation of normal procedures and combinations was also carried out (Figure 4). It can be seen from here that the device has not been subjected to any external attacks.

Fig. 4 Mikrotik router's log file indicating no attempted attacks.

Based on the indicators presented in Figures 3 and 4, it can be determined that there is no threat of attack observed on the device. This can be explained by the absence of any attempts to access the device from outside and the consecutive increase in processor load.

To investigate the process of a potential attack, a simulation of an attack process was carried out on the device. Different patterns were observed in the logs and processor activity during the simulated attack process. The log information for the attack simulation is provided in Figure 5. From the logs, it is clear that there were login attempts under user names such as "admin" and "supervisor" at intervals of 1 or 2 seconds.

Fig. 5 Log indicators of attack attempts on the Mikrotik router

Based on the observed activity, the management system can suspect the possibility of a threat and take various measures to protect the device. In the case being examined, the main resource is considered to be the processor, since the processor's overload can cause other processes to slow down or stop. At the same time, based on the processor's load spikes, it is possible to determine the

extent to which the attack is continuous and dangerous.

As mentioned earlier, even during normal traffic loads, there can be various spikes. The first spike can be explained by normal traffic load. However, the consecutive second spike can be considered as a possibility of an attack. But the spikes that continue with increasing frequency, starting from the third spike, should be interpreted as a significant threat of an attack. As a result of the conducted experiment, the spikes observed in the processor due to the simple attacks performed on the MikroTik router are provided below (Figure 6).
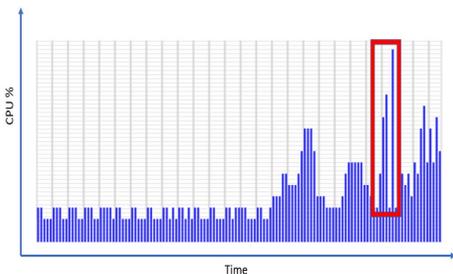
Fig. 6 Processor Load during Attack on MikroTik Router

As seen from Figure 6, during the attack, there is a short-term sequence of increasing spikes in processor activity. These spikes represent, for example, 11% at the 1st second, 13% at the 2nd second, 17% at the 3rd second, and 25% at the 4th second of the attack. For clarity, the graph of the dynamics of the changing indicators depending on time can be constructed as shown in the following Figure 7.
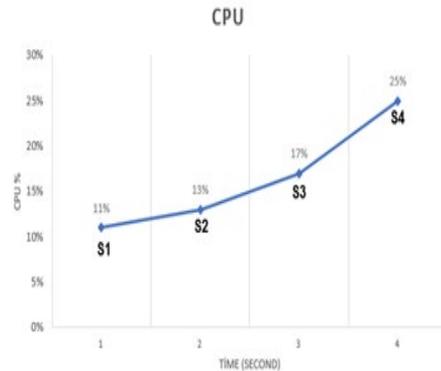
F

ig. 7 Graphical representation of the device's processor load during the attack

Based on the above information, let's formalize the measure for detecting a hacking attempt based on processor usage data.

Let's denote the maximum value of the monitored indicator in normal operation as S_o. For the purpose of determining a hacking attempt, let's consider the moments of recording the indicator during the monitoring process as $t_i, i = 1, 2, 3, ...$ and let S_i represent the value of the indicator at time t_i. It is evident that if an attempt has occurred at a certain t_i, then the condition $S_i > S_0$ must be satisfied. However, as mentioned above, this condition can also occur due to random fluctuations. To identify a ongoing hacking event, the values of S_i at observation moments $t_{i+k}, k = 1, 2, 3, ...$ which are not too

far apart in time, should be analyzed. For this purpose, at certain time intervals, the values of S_{i_k} at t_{i_k} $t_{i_k}, k = 1, 2, 3, 4$ should be examined in such a way that the following conditions (1) and (2) are met:

$$S_{i_k} > S_0 , \qquad (1)$$

$$t_{i_4} - t_{i_1} < 8 . \qquad (2)$$

Based on numerous experiments, it has been shown that the difference between $S_{i_{k+1}} - S_{i_k}$ for $k = 1, 2, 3$ increases monotonically with a certain proportionality factor α. If we denote the proportionality factor by α, the indicator for a potential attack can be formulated as follows:

$$S_{i_{k+1}} - S_{i_k} \geq \alpha \cdot \left(S_{i_k} - S_{i_{k-1}} \right), \qquad (3)$$

The note states that conducted experiments show that the difference values increase twice during an attack, in other words,

$$\alpha \approx 2. \qquad (4)$$

Thus, to determine the attack risk based on the processor's loading activity, the following rules can be given in accordance with relations (1)-(4).

Rule 1 - If there are 1 or 2 jumps in the processor per 1 second interval, this should be considered as a normal jump.

Rule 2 - If there are 3 jumps in a 1 second interval, these jumps should be considered suspicious, and the occurrence of the 4th jump should be monitored with probability.

Rule 3 - If 4 jumps occur in a 1 second interval, this should be evaluated as an attack risk and calculations should be performed to determine whether there has been an intensive increase between the jumps.

Rule 4 - If the difference between the 4th jump and the 3rd jump is twice as large as the difference between the 3rd and the 2nd jump, and the difference between the 3rd and the 2nd jump is twice as large as the difference between the 2nd and the 1st jump, then it is verified that an attack has occurred on the device.

Based on these rules, a program has been developed in the Python programming language, tested with appropriate tests, and yielded positive results. Below is an example of the program code:

```
import psutil
import time
# Define function to check for CPU spikes
def check_cpu_spike():
    # Get CPU usage for first second
    cpu_usage1 = psutil.cpu_percent(interval=1)
    # Get CPU usage for second second
    cpu_usage2 = psutil.cpu_percent(interval=1)
    # Get CPU usage for third second
    cpu_usage3 = psutil.cpu_percent(interval=1)
    # Get CPU usage for fourth second
    cpu_usage4 = psutil.cpu_percent(interval=1)
    # Check if there was a spike between first and second seconds
    spike1 = cpu_usage2 - cpu_usage1
    # Check if there was a spike between second and third seconds
    spike2 = cpu_usage3 - cpu_usage2
    # Check if there was a spike between second and fourth seconds
    spike3 = cpu_usage4 - cpu_usage3
    # If the second spike is twice as large as the first spike, print "there
was a change"
    if spike2 >= 2*spike1:
        print("there was a change")
    # If the third spike is twice as large as the second spike, print "there
an attack"
    if spike3 >= 2*spike2:
        print("there was an attack")
# Call function to check for CPU spikes
check_cpu_spike()
```

5. CONCLUSION

As a result of experiments conducted with a Mikrotik router acting as a gateway, it has been determined that it is possible to detect a cyber attack by monitoring the device's internal resources for various activities. To this end, login attempts with various user names identified in the Mikrotik router's logs, as well as the processor's jump activity, have been monitored. Metrics indicating when increasing sequential jumps are related to attempted attacks have been identified based on the observed indicators. An algorithm has been developed based on these metrics, and a program has been written in

the Python programming language and tested to detect cyber attack threats against the device.

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ASSESSMENT OF WEAPON SELECTION FOR ACHIEVING GUARANTEED VICTORY IN TACTICAL ACTION

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The paper deals with the problem of securing a guaranteed victory for our side in the course of military operations, when the dynamic power of the enemy is known. The problem of the set of weapons for a guaranteed victory is solved. A method is given for calculating the set of weapons and equipment that guarantees victory without regard to information on the set of weapons and equipment of the opposing side for any set. The method of composing and solving matrix games in game theory is used. The problem is modeled as a matrix game with mixed strategies, and the existence of its solution (saddle point) is shown in this setting. To obtain a numerical solution of the problem, the matrix game is reduced to the linear programming problem.

Key words: weapon category, weapon impact index, ability to destroy the weapon, static power, dynamic power, mixed strategy, cost function.

1. INTRODUCTION

Success of any tactical activity is contingent upon its proper organization. This depends, along with the numerous factors, on the one hand, on the total power of weapons and equipment gathered by the enemy in the area of operations on the basis of intelligence data, and on the other hand, on the selection of weapons and equipment intended to destroy them. Determining the number of required weapons and equipment depending on its form, type, operational conditions during the preparation of an offensive battle is explained in a number of scientific and technical literature.

Classical approaches to the order of selection of weapons are reflected in textbooks and in instructions. (e.g. Babayev:2017, Babayev:2016a et al 2016, Popov:2005, Aldo:2013).

Among novel studies, the issue of the optimal choice of resources used to achieve victory was considered in the works of S.Babayev based on information about the weapons and equipment of

the enemy. The value of the equipment and weapons used or the number of probable casualties was taken as the optimality criterion (e.g. Combat:2015, Tank:1997, Babayev:2016b).

The experience of recent military conflicts in different parts of the world shows that information on the weapons and equipment of the opposing side is not sufficiently accurate, but it is possible to obtain information on their overall dynamic power on the basis of various indirect estimates (e.g. Onişor:1999, Bowdish: 2013).

Depending on the intended tactical action, the power of the weapon and equipment required to defeat an enemy of known strength is usually considered known. It is clear that the options for organizing forces with such power can be different.

This article studies the rule of optimal organization of forces to achieve a guaranteed victory, regardless of the choice of weapons, when the enemy's dynamic strength is known.

2. BASIC CONCEPTS OF MILITARY OPERATIONS

A number of concepts that characterize the weapons used in military operations (e.g. Mark: 2016) is essential for the purposes of this article and is briefly overviewed below.

The meaning of the weapon category. Depending on the type of operation (offensive or defensive), the concept of the meaning of weapons and equipment related to each category (category of importance) is included. According to their purpose and role in military operations, military weapons and equipment are divided into 10 categories. The value of weapons and military equipment for different categories is given in the form of tables in the military-technical literature. (Aldo:2013, p.2, Popov: 2005, p.43). It should be noted that the numbers given in the tables are relative in nature, depending on the opinion of experts, their mutual ratio may have different values in different sources. (Aldo:2013, p.7, Popov:2005, p.44).

Weapon impact index. Weapons belonging to one category or another differ from each other in terms of their tactical and technical indicators, and a power index is used to show this diversity. (Aldo:2013, p.2, Popov:2005, p.43).

The power index of the weapon is determined depending on its firing capability, maneuverability in military operations, operational capability and application. This indicator is calculated separately for each weapon type and is fixed. The power indexes are calculated by

specialists in this field at weapons factories (Aldo:2013, p.6, Popov: 2005, p.44).

Weapon effectiveness index. During military operations, the extent to which weapons and military equipment can destroy enemy forces is characterized by its effectiveness. It is considered that the weapon effectiveness coefficient depends on the nature of the combat work, and the following formula can be used to calculate it. (Aldo: 2013, p.7, Popov: 2005, p.43):

$$E = K \times T \qquad (1)$$

Here E - effectiveness index, T - weapon effect index, K - the importance of the category to which the weapon belongs. It should be noted that depending on the nature of the military operation K is different. For example, in the offensive battle of the tank, the effectiveness coefficient is $E = 2$ with the importance of the category K=1, and the effect index $T = 2$.

In a defensive battle when K=3, effect index is $T = 2$ effectiveness coefficient is $E = 6$.

Static strength of a military unit (divison). Static durability characterizes units in terms of available weapons and is determined by the overall rating of all types of weapons available in units. The following formula is used to calculate the static strength of a military unit or division (Aldo:2013, p.8, Popov: 2005, p.45):

$$S = \sum_{j=1,2,\dots} N_j \cdot E_j \qquad (2)$$

Here, S – static strength of unit, j - serial number applied in any order to the various weapons belonging to the combination $(j = 1, 2, \dots)$, E_j - effectiveness coefficient of j type weapons which determined by the formula (1), N_j – number of j type weapons which belonging to unit.

Dynamic strength of a military unit (division). Military experts recommend to note the specifics of the operation (for the attacking side - the form and type of attack, for the defending side - the level of readiness of the defense, the state of the barriers created) to assess the results of the battle. The indicator calculated taking into account these factors is called dynamic strength. (Aldo:2013, p.19, Popov: 2005, p.43).

The comparative advantage coefficient is used to calculate the dynamic strength. This coefficient shows the degree of superiority of different units (tank, motorized rifle, etc.) over each other and are given in the relevant tables uyğun (table 1) (Aldo:2013, p.19, Popov: 2005, p.43).

Table 1. The comparative advantage coefficient

Units	Tank	Motorized rifle	Small arms
Tank	1.0	1.7	2.0
Motorized rifle weapons	0.6	1.0	1.7
Small arms	0.5	0.6	1.0

Using the comparative advantage coefficient
the dynamic strength of the parties is calculated by formulas (3) - (5):

$$D_1 = U_{1,2} \cdot I_1 \cdot S_1, \qquad D_2 = I_2 \cdot S_2, \quad (3)$$

Here, S_1 and S_2 is a static strength of own and opposite sides, respectively, $U_{1,2}$ - coefficient of comparative advantage of one's side in comparison with the opponent's side.

I_1, I_2 and their numbers are determined as follows: - when their side is on the attack

$$I_1 = H_1 \cdot H_2, \qquad I_2 = M_1 \cdot M_2, \quad (4)$$

- when their side is defense

$$I_1 = M_1 \cdot M_2, \qquad I_2 = H_1 \cdot H_2, \quad (5)$$

Here, H_1 - attack form coefficient, H_2 - attack type coefficient, M_1 - defense readiness coefficient, M_2 – is called obstacle condition coefficient. Their value is given in table 2-5. (Aldo:2013, p.20, Popov: 2005, p.47).

Table 2. Attack forms

Attack form	Coefficient	
Frontal attack	1.0	
Flank attack	2.0	
Attack from behind	4.0	
Air landing	at the beginning of the battle	0.5
	after 2 hours	4.0
Amphibious warfare	at the beginning of the battle	0.7
	after 2 hours	1.0

Table 3. Attack types

Attack fom	Coefficient
Repared attack	1.0
Face-to-face battle	1.2
Sudden attack	1.5

Table 4. Preparedness defense degree

Time taken to prepare the defense before the start of the operation	Coefficient
less than 6 hours, unprepared	1.0
from 6 hours to 24 hours	1.2
more than 24 hours	1.4
Long-term, provided with facilities	2.0

Table 5. The barrier system state

State of bariers	Coefficient
No barriers	1.0
Weak barriers	1.2
Medium barriers	1.4
Strong barriers	1.6
Too strong barriers	1.8

3. STATEMENT OF THE PROBLEM

When the dynamic strength of the opponent is known, the right choice of weapons must be made to achieve a guaranteed victory. In classical approaches, information about the number of weapons possessed by the opposing side is used to study the organization of tactical activities. For example, selection of weapons and equipment, minimizing their overall cost in (Babayev: 2016b), was carried out under the condition of minimizing possible manpower losses in (Babayev:2016c).

In the presented work, it is considered that only the dynamic strength of the enemy's forces is known. It requires a choice of weapons and equipment in order to achieve a guaranteed victory, regardless of the resources on which the dynamic power of the enemy is formed.

The method used to solve the problem is based on antagonistic game theory. Thus, the study of the organization of tactical activity is carried out with regard to the attacking or defending side. The task is solved by finding a saddle point, which is used in game theory (Wentzel: 2001, p.182).

As is known, models and methods of decision-making in conflict situations are studied in game theory. Considered problem is an antagonistic decision-making problem for two players.

To state the problem, let's give a brief introduction to some game theory concepts. In the considered type of antagonistic game, it is required that the given cost function be maximized by player I and minimized by player II. If the desicion made first by player I and then player II, then the resulting value of the cost function is called maxmin, if the decision is made first by player II and then player I, then the resulting value of the cost function is called ***minmax***. When maxmin equals minmax, this valie is called the price of game and the option that realizes this price is called the saddle point. One class of antagonistic games is called matrix games. The game is implemented by choosing one of the players the rows of the matrix and the other the columns of the matrix. At this time, the meaning of the different options of the parties is determined by the elements of the matrix. If the parties in the game are able to choose only one row and one column, such game is called a pure strategy game. It is well known that pure strategy matrix games do not always have a saddle point. If the parties in the game are able to choose different rows and columns with certain weights, such game is called a mixed strategy game. It is known from game theory

that a mixed strategy game always has a saddle point, in other words, there is always a solution for a mixed strategy game. (Wentzel: 2001, p.182).

If the dynamic strength of the opponent is known, so let's express the issue of weapon selection based on game theory terminology. Let's number the types of weapons and equipment that the enemy can use as $j = 1,2, \ldots, n,$ and the types of methods our side can use as $i = 1,2, \ldots, n,$. Let's denote theability of i -type weapon to destroy the j -type of weapon as $c_{i,j}$. In military affairs quantities of $c_{i,j}$ are considered known (e.g. Onishor:1999, Bowdish: 2013), calculated according to the tables above. $c_{i,j}$ -s can be represented as the following matrix C:

$$C = \begin{pmatrix} c_{1,1} & \cdots & c_{1,n} \\ \cdots & \cdots & \cdots \\ c_{n,1} & \cdots & c_{n,n} \end{pmatrix} \quad (6)$$

In the following formulas, we will differentiate the quantities related to the parties participating in the military operation, with the superscript index $s = 1,2$ written in. Let $x_i^{(s)}$ denote the number of the s party wants to involve in the operation from the i type of the weapon. Then, the dynamic strength of the parties for the used weapons calculated according to next formulas.

$$\sum_{i=1}^{n} d_i^{(s)} x_i^{(s)} = D^{(s)}, \qquad s = 1.2 \quad (7)$$

The determinant of the matrix C can be taken non-zero, so that all elements of the matrix are non-zero, and the problem statement remains unchanged if the value of any element is changed slightly. Denote $\|C\| = \det(C)$. The matrix(6) can always be written as $C = \|C\| \cdot E$, where

$$E = \begin{pmatrix} e_{1,1} & \cdots & e_{1,n} \\ \cdots & \cdots & \cdots \\ e_{n,1} & \cdots & e_{n,n} \end{pmatrix}.$$

It is clear that the elements of the matrix E are calculated as follows and can be considered known:

$$e_{i,j} = \frac{c_{i,j}}{\|C\|}, i,j = 1,2, \ldots, n.$$

Let first side weapon choice is $x_i^{(1)}$, $i = 1,2, \ldots,$ and second one weapon choice is $x_j^{(2)}$, $j = 1,2, \ldots, n.$ Depending on the type of mutual operation carried out by the parties (for example, attack-defense), if we denote the dynamic power conditioned by each weapon as $d_i^{(1)}$, $i = 1,2, \ldots, n$ and $d_j^{(2)}$, $j = 1,2, \ldots, n$ respectively. For the first side the dynamic power corresponding to the number of weapons $x_i^{(1)}$ is equal to $d_i^{(1)} x_i^{(1)}$, for the second side the dynamic power corresponding to the number of weapons $x_j^{(2)}$ is $d_j^{(2)} x_j^{(2)}$. Then according to the proposed requirements regarding the total

dynamic power of parties can be calculated as

$$D^{(1)} = \sum_{i=1}^{n} d_i^{(1)} x_i^{(1)}, \qquad (8)$$

$$D^{(2)} = \sum_{j=1}^{n} d_j^{(2)} x_j^{(2)}. \qquad (9)$$

Here, $D^{(1)}$ and $D^{(2)}$ are known quantities.

We will distribute the dynamic power distribution vector (8) $i = 1,2,\dots,n$ by given types of weapons as $\boldsymbol{\Lambda} = (\lambda_1, \lambda_2, \dots, \lambda_n)$, and the dynamic power distribution vector (9) by given types of weapons $j = 1,2,\dots,n$ as $\mathbf{M} = (\mu_1, \mu_2, \dots, \mu_n)$:

$$\lambda_i = \frac{d_i^{(1)} x_i^{(1)}}{D^{(1)}}, \qquad (10)$$

$$\mu_j = \frac{d_j^{(2)} x_j^{(2)}}{D^{(2)}}. \qquad (11)$$

From the definitions (10) and (11) it is clear that

$$\sum_{i=1}^{n} \lambda_i = \sum_{i=1}^{n} \mu_i = 1.$$

Then, according to the distribution vector $\boldsymbol{\Lambda}$, the force created by all weapons of the first side against one unit j weapon of the second side will be calculated as

$$\sum_{i=1}^{n} e_{i,j} \lambda_i. \qquad (12)$$

In order for the power calculated according to (12) to correspond to the dynamic power of the corresponding (j-th type) weapon of the second side, we distribute it between these means along the vector $\mathbf{M}$. Then, if we calculate the dynamic power directed by the i type of weapon against j type of weapon of the second side so that the first side does not lose the game, then we get the expression $e_{i,j} \lambda_i \mu_i$.

It is easy to see that this expression is calculated as the elements of the following matrix product:

$$A = \mathbf{M} \cdot \mathbf{E} \cdot \boldsymbol{\Lambda}.$$

The sum of the elements of matrix A can be taken as the cost of the game:

$$J \equiv \sum_{j=1}^{n} \sum_{i=1}^{n} e_{i,j} \lambda_i \mu_j. \qquad (13)$$

Let take the following notation:

$$x^{(1)} = \left(x_1^{(1)}, \dots, x_i^{(1)}, \dots, x_n^{(1)} \right),$$

$$x^{(2)} = \left(x_1^{(2)}, \dots, x_j^{(2)}, \dots, x_n^{(2)} \right).$$

If we express the quantities λ_i and μ_j from formulas (10) and (11) by $x_i^{(1)}$ and $x_j^{(2)}$, and the elements of the matrix $\mathbf{E}$ express by the elements of the matrix $\mathbf{C}$, the function (13) will be written as follows:

$$J\left(x^{(1)}, x^{(2)}\right) \equiv \frac{1}{D^{(1)} D^{(2)} \|C\|} \times$$

$$\times \sum_{j=1}^{n} \sum_{i=1}^{m} c_{i,j} d_i^{(1)} d_j^{(2)} x_i^{(1)} x_j^{(2)} \qquad (14)$$

The function $J\left(x^{(1)}, x^{(2)}\right)$ is linear in both its arguments. From

game theory, it is known that function (14) has a saddle point, i.e.,

$$\min_{x^{(1)}} \max_{x^{(2)}} J(x^{(1)}, x^{(2)}) = \max_{x^{(2)}} \min_{x^{(1)}} J(x^{(1)}, x^{(2)}).$$

Thus, the question of choosing a weapon to achieve a guaranteed victory can be formulated in the language of the theory of matrix games as follows:

- The value of the function $J(x^{(1)}, x^{(2)})$ is maximized by the first player (our side, by choosing the parameter $x^{(1)}$), and the second player (the opposite side, by choosing the parameter $x^{(2)}$) minimizes it.

4. REDUCING THE TASK TO THE LINEAR PROGRAMMING PROBLEM

Denote the cost of the game by U:

$$U \equiv \max_{x^{(2)}} \min_{x^{(1)}} J(x^{(1)}, x^{(2)}). \quad (15)$$

By considering the condition for each $j = 1, \dots, n$, $\mu_j \geq 0$ and $\mu_1 + \cdots + \mu_n = 1$, so from the obvious form of the function $J(x^{(1)}, x^{(2)})$, we can get next equality

$$\sum_{i=1}^{n} \left(\frac{1}{\|C\|} \sum_{j=1}^{n} C_{i,j} \right) \frac{d_i^{(1)} x_i^{(1)}}{D^{(1)}} \leq U. \quad (16)$$

If we denote

$$y_i = \frac{d_i^{(1)} x_i^{(1)}}{D^{(1)} U} \quad (17)$$

the inequalities (16) can be written as follows:

$$\sum_{i=1}^{n} H_i y_i \leq 1, \quad j = 1, 2, \dots, n, \quad (18)$$

here $H_i = \frac{1}{\|C\|} \sum_{j=1}^{n} C_{i,j}$. According to (17), it is clear that

$$y_i \geq 0, \quad i = 1, 2, \dots, n. \quad (19)$$

From the other hand, according to equations of (8) and (17)

$$\sum_{i=1}^{n} y_i = \frac{1}{U} \sum_{i=1}^{n} \frac{d_i^{(1)} x_i^{(1)}}{D^{(1)}} = \frac{1}{U}.$$

From the equivalence of the requirement $U \to \min$ to the requirement $\frac{1}{U} \to \max$, it is obtained next criteria from the last equation

$$\sum_{i=1}^{n} y_i \to \max. \quad (20)$$

Thus, the (15)-(17) matrix game of mixed strategies reduces to a linear programming problem (18)-(20) and can be solved, for example, using the simplex method (Wentzel: 2001, p.52).

5. CONCLUSION

One of the characteristics of tactical groups in combat operations is dynamic power. Dynamic power is calculated on the basis of the combat conditions, the planned combat, and the weapons and equipment used. Thus, the assessment of dynamic power

depends on the set of weapons and equipment.

The proposed approach can be used to select weapons during the tactical planning phase when there is an overall estimate of the enemy forces. This requires that the coefficients of the ability of each type of weapon to destroy other types of weapons be known. But the diversity of the fleet of military weapons and equipment of different countries and their new modifications in recent years require that appropriate research be conducted to calculate these coefficients. It is assumed that the coefficients expressing the ability of each weapon to destroy other weapons are known.

In the paper, the problem of selecting weapons and equipment to achieve a guaranteed victory in tactical actions, when the dynamic power of the enemy is known, is simulated as a mixed strategy matrix game. It is shown that the resulting game theory problem can be reduced to a linear programming problem and solved by numerical methods. The selection of weapons and equipment can be considered and solved as a mixed strategy matrix game.

It can be noted that in other conflict situations, if it is possible to calculate the interaction of relevant factors, it is possible to use game theory to calculate a guaranteed result.

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TARGETING A ROCKET AT A MOVING OBJECT USING UNMANNED AERIAL VEHICALS (UAVs)

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This article discusses the evolving nature of modern warfare, emphasizing the shift towards, autonomous weapons and artificial intelligence-driven military operations. İt underscores the importance of high-tech combat vehicles, the need for constant improvements in military capabilities, and the role of well-trained units in achieving victory such as the Second Karabakh War and the Russian-Ukraine War. The article particularly focuses on the secure transportation of military personnel in warzones and the challenges associated with it. It highlights the use of unmanned aerial vehicles (UAVs) for constant observation, reconnaissance, and directing artillery missiles to enhance the safety of personnel during transport. The main research objective is to solve mathematically the problem of directing unguided rockets to destroy enemy vehicles in motion. The article presents a mathematical model for this purpose, taking into account various factors such as coordinates, speed, and trajectory of enemy vehicles. It also discusses the practical applications of this model in military scenarios. İn conclusion, the article emphasizes the significance of technologies advancements, especially in the use of UAVs and guided artillery projectiles, in modern warfare. İt offers a mathematical approach to targeting moving enemy vehicles, contributing to the development of military tactics and strategies.

Key words: *Unmanned aerial vehicles, armored vehicles, movement trajectory, artillery shell, combat weapons*

1. INTRODUCTION

Modern wars are waged involving few personnel upgraded combat vehicles requiring state of art technology. However, in the future wars occur between autonomous weapons or distant command weapons functioning with artificial intelligence [1-3]. In those battles in which artificial intelligence or distant command unmanned aerial vehicles and weapon systems perform,

technological advantages will come forward, more rapid and accurate information delivery will be possible between command control centers and decision makers [4-7]. Accordingly, throughout the, modern battles the number of damaging vehicles are widely so constant improvements and fighting qualities of these vehicles lead to high accuracy, increasing the distance and damaging effect. Meanwhile all these factors truly provide combat opportunities of damaging vehicles, whole army and military units. Battles and military confrontations usually tend to reflect themselves in more dynamic and frequently changing conditions. Modern wars mostly stand out with their determination, high maneuverability and tension as well as new combat strategies. In the course of battles and military operations, the application of ordinary, but modern damaging vehicles manage to arise deep chaos among enemy troops within a short period of time. Research it is doubtlessly possible to carry out the combat mission in scheduled time and without having casualties by coordinating all artillery fires. Despite this, in order to perform this task the most essential condition to consider is the artillery units must have high combat readiness and benefit from up to date technologies.

Second Karabakh War and Russian-Ukrainian War proved the presence of well-trained units the key of victory. Moreover the secure transportation of this military personnel between warzones is the most crucial and trouble-making issue. While the progress of the wars we realize the battles a portion of military personnel become victim while being transported. According to this figure covers 10 to 20 percent of total personnel. In this regard, massive application of unmanned aerial vehicles in military operation zones guarantees the constant observation of these relocating vehicles, acquiring reconnaissance information, directing artillery missiles and fire impact on these regions [8, p.231].

It has to be emphasized that by hiring up to date unmanned aerial vehicles and other scout tools to find the solution of military based geoinformation systems, scanning the territory and exposing the covered objects, locating the coordinates of certain objects, besides guiding the rockets and artillery shells towards the target and so on [9-15].

As it has been displayed, until the recent combat tactics the field of activity for attacking combat units is supposed to be out of the area as they could be hit by enemy artillery troops. This operation field has to be 8 to 10 kilometers away from the defensive line of the enemy whereas small attacking units can be distance of 4-5 kilometers from the enemy troops. Considering this decreasing figure, firing positions are arranged behind natural cliffs and hills [16, p. 132].

However, application of innovative unmanned aerial vehicles and reconnaissance, approaching in

extensive units, detachments or platoons can be quite risky, even fatal.

Additionally, one of the further capabilities of unmanned aerial vehicles is directing the GPS-based missiles and mines towards certain targets [17, p.7; 18, p.373]. There is a military truck carrying roughly 20-30 enemy personnel coming close to the border, obviously this vehicle has to be shot down immediately. Annihilating the armored vehicles belonging to enemy troops is counted the best way to disrupt their plans.

In the article detecting what speed enemy vehicles are moving at, where they are exactly located depend on the plan of the enemies, terrain features, calculating predictable moving trajectory of enemy vehicles and considering the straight flight of unguided missiles, how to direct this missile to the target widely described.

The essential purpose of this research is to mathematically solve the matter of how to destroy enemy machines by directing unguided rocket. Practically an unguided missile to the target in motion is the scientific innovation of this report. Result of the research mathematical solution how to eliminate the enemy vehicles by using a rocket.

1.1. The mathematical model of how to guide an artillery shell to the target

The essence of the matter. It is believed that enemy vehicle is detected in certain amount of time, and the immediate coordinates and

speed of it are determined accordingly [2]. Additionally, it is supposed that taking into account combat itinerary and terrain features the calculation of predictable movement of enemy vehicles is possible. This trajectory can be designed in the spline model [19-21].

It is strongly demanded that with the purpose of hitting the enemy vehicle the flying course and distance to the target have to be determined.

Being sure about the straight flight of the unguided rocket the movement of the target on the ground or terrain may not be as necessary compared to the flight height of the rocket. Alternatively directing an unguided rocket to any target can be, conducted with claim coordinates.

1.2. Mathematical formalization of the issue

If you intend to develop the mathematical model of the matter, you have to include Oxy rectangular coordinate system. You are supposed to arrange this coordinate system in a such way that the beginning of it coincide the region where the enemy vehicles assemble. The axis 0y should be aimed to the North (Fig.1).

Let's imagine any enemy vehicle has been detected in any t_0 moment and this vehicle is rushing towards the area where the coordinates begin. It is believed that the speed as well as the moving trajectory of it according to its combat task, terrain features and Oxy coordinate system has been computed. Depending on the time $t \geq t_0$, let's

mark the moving trajectory as $(x_1(t); y_1(t))$. Apparently, $x_1(t)$ və $y_1(t)$ functions will be counted as stable functions. Moreover, we are likely to think the function $y_1 = y_1(x_1)$ is monotone.
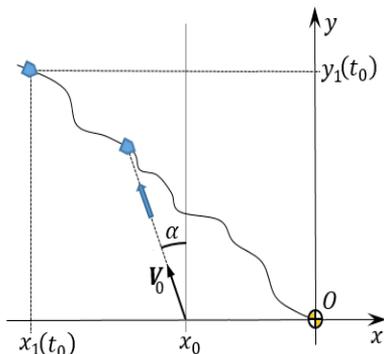
Fig.1 Scheme of movement of enemy vehicle

In order to simplify the matter the vehicle receiving reconnaissance data about enemy vehicle is positioning on certain points like $(x_0; 0), |x_0| \leq |x_1(t_0)|$ along the line of $\{y = 0\}$. If it is marked the speed of launched rocket with V_0 and possible azimuth angle of it with α. If it is defined – the angle that falls between north direction of the meridian and given direction is called azimuth and it is measured with clockwise direction. The figure of azimuth changes between 0 and 360 degree. The angle measured basing on an actual meridian is called the actual azimuth (A). The angle measured for magnit meridian is titled magnit azimuth (Am), whereas the angle measured starting from the ask

meridian is called steering angle (Fig.2) [22, p. 60].
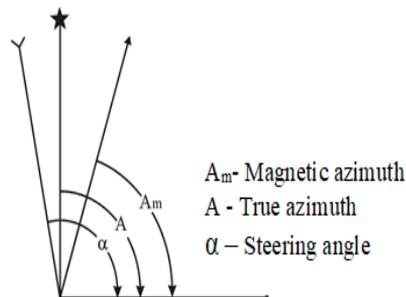
Fig.2 Direction angles

The matter directing and unguided rocket to enemy vehicles can be defined as below:

– Following spending some time to process, the received data during the period of t_1 and artillery shell is launched to annihilate the enemy vehicle. We are supposed to find such t_2 moment and α angle, the rocket launched at the moment of t_1 has to unite with the enemy vehicle at the moment of t_2.

Problem solving: Taking into account all mentioned above the formulas of the moving rocket may be written as below:

$$\begin{cases} x(t) = x_0 + V_0 \cdot \sin\alpha \cdot (t - t_1), \\ y(t) = V_0 \cdot \cos\alpha \cdot (t - t_1). \end{cases} \quad (1)$$

The condition of how a rocket reaches enemy vehicle should be described as below:

$$\begin{cases} x_1(t_2) - x_0 = V_0 \cdot \sin\alpha \cdot (t_2 - t_1). \\ \quad y_1(t_2) = V_0 \cdot \cos\alpha \cdot (t_2 - t_1). \end{cases} \quad (2)$$

If we square up the equations and add them according to the t_2 we may infer this equation:

$$(x_1(t_2) - x_0)^2 + y_1^2(t_2) - V_0^2(t_2 - t_1)^2 = 0. \quad (3)$$

It is illustrate that for during of the short time indicator $x_1(t)$ or $y_1(t)$ functions are stable. We can localize the possible solutions of the equation and solve it with the help of dichotomy [23, p.190,197].

Consequently, one or several numbers can be found for t_2. Our mission is to select top number among figures. Following this α angle from equation system can be calculated as below.

$$\alpha = \text{arctg}\frac{x_1(t_2) - x_0}{y_1(t_2)}. \quad (4)$$

The way of inhillation of the enemy vehicle which is detected immediate coordinates and moving speed of it have been determined as well as how to solve it, all this mentioned stuff has been presented in the essence of the matter. By benefiting from this equation it is possible to destroy the combat column of the enemy troops containing armored vehicles.

1.3. Some aspects of shooting casualties to columns

As a principal shooting casualties colomns are performed in order to block or decelerate the movement of them. With the purpose of correcting the fires and reconnaissance of the columns radiolocation station named SNAR, quantum range finder and helicopter are involved this task.

The whole division is mobilized to fire at infantry, an automobile column in the size of 700 meter leng. Meanwhile, a column itself is considered a target point. In case the column is long, several divisions are mobilized. Thereby, one of the divisions performs fire to the front enemy column. The fires of the rest division have to be splitted along the enemy columns in a such way the distance between two target points of the division should not be more than 700 meters. As long as firing at the enemy columns containing tanks, self-propelled howitzers and other vehicles. Two divisions equipped with 100 mm and other heavier howitzers are also involved into this operation.

To fire at columns some combat preparations are held beforehand. In order to achieve this goal division commander attempts to locate the possible routes of the enemy vehicles on the map. And all these routes are drawn on a tablet by the chief of radiolocation station.

On marked movement routes the commander of division teams up with the chief of radiolocation station, they start to mark passages and bridges,

narrow slopes, road intersections as meeting points. If the movement of the enemy column doesn't coincide with any route, the movement routes and the meeting points of it are determined according to the results of cuts.

The data for casualty shot is determined with full preparation method or by referring to the information gathered by an experiemental howitzer. During the fire preparation against the pre-recorded routes if the condition is suitable. The indicators for casualty shots are experimented one by one [24, p.153-155].

The loss of columns are held with frequent combat raids. If it is uncovered that the enemy column has suspended after the fire raid we can possibly proceed the raids by correcting some indicators. While the column is in motion new fires get prepared for further meeting points. And eventually fire attack is successfully carried out. In this case while shooting at the initial targets some lateral deviations are noted.

The division carries out the shooting at enemy column with a scale equalling to 100 meters. Whereas regardless the moving direction of the column there is fifteen meters distance two range fans [24, p.153-155].

Besides this, to destroy the armored targets and military bases with just a single shot 152 mm and 155 mm howitzers with reactive engines, the artillery ammunition with

accuracy named Krasnopol are widely used [25].

The flight of an artillery projectile towards the target is carried out with aerodynamics surfaces depending on lasers. If you want to extend fire range of the shell you have to take an advantage of reactive engine and gas generator. Highly developed aerodynamic surfaces guarantee the planning of targets. It extends fire range of the shell and diminish the height. During the usage of this ammunition we may get great outcomes from the application of unmanned aerial vehicles. Having the top starting speed, big size warhead, low price make this ammunition absolutely different from rockets.

2. CONCLUSION

Unmanned Aerial Vehicles are used as a tool in order to conduct reconnaissance damage by fire and coordinate artillery strikes. It led to some changes related to combat tactics and established a unique innovation in terms of running large-scale battles. Consequently, the combat tactics involving UAVs considerably vary from any ordinary combat tasks. This difference reflects itself in the scale of war, the combat capability of enemy, as well as battles in hard terrain. Obviously, economical issues are as important as a human factor. The application of UAVs in military operations requires great deal of budget. Meanwhile by using unguided artillery projectiles and

estimating the data accurately we can possibly hit the targets.

The mathematical approach proposed above provides a possibility of how to direct an unguided projectile to moving targets or a column of enemy troops. It lets to build the mathematical model and algorithm of it.

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OPTIMAL MANAGEMENT OF THE APPLICATION OF A GROUP OF UNMANNED AERIAL VEHICLES (UAVs) OF THE SAME TYPE TO DIFFERENT TARGETS

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In the article, a mathematical modeling method is applied to solving the combat activities of cumulative, thermobaric and fragmentation missiles used by a group of unmanned aerial vehicles against tanks (armored combat vehicles), air defense equipment, infantry group, and long-term firing point targets under favorable and unfavorable conditions. The results show the possible to determine the minimum and maximum number of destroyed targets. These results can be used in the optimal management of the combat activities of a group of unmanned aerial vehicles of the same type.

Key words: group of unmanned aerial vehicles of the same type, different targets, mathematical modeling, optimal management.

1. INTRODUCTION

The 21st century is called the age of technology, and it is developing rapidly. Its influence covers all fields and has had its effect on UAV technology as well. Currently, UAVs are widely used in various fields and it creates great opportunities. In addition to UAVs used in the civil field, various purpose strike, intelligence and multi-purpose UAVs are used in the military [1]. UAVs are made on the basis of high technologies. Elements of artificial intelligence and software ensure that UAVs belong to the category of high-precision weapons. The capabilities of UAVs exceed the results achieved by human labor several times. By staying in the air for a long time, UAVs facilitate the acquisition of any information and decision-making for the command that plans and directs combat operations. The destruction of the enemy provides a great advantage over the opponent by detecting the targets that are considered necessary and striking at the right time.

During the last ten years, the dynamics of the use of UAVs during combat activities has been increasing

according to a positive trend. UAVs, which are individually involved in the execution of ordinary tasks, are currently widely used on a massive scale. By performing various combat tasks, they reduce the loss of personnel, thereby ensuring that an advantage over the opponent is obtained in a short time. At present, armies equipped with modern UAVs directly consider the advantage gained by their application according to the tactical situations and possible scenarios that have arisen in various types of combat. UAVs, being applied in the most complex conditions, can influence the development scenario of combat activity and direct it in the direction that suits us. Well-known military experts study the results of the Second Karabakh War, in which UAVs were widely used by various types of troops, and anti-terrorist operations conducted by the Turkish Armed Forces in northern Syria and Iraq. The combat use of UAVs in the Russian-Ukrainian war maintains its relevance. In the Russian-Ukrainian war, UAVs hit military facilities as well as more important infrastructure facilities (power plants, transformers, water pumps, etc.). Wars conducted with the use of new generation high-precision weapons require its detailed study. The main goal is to plan various scenarios of the effective application of UAVs and their mathematical modeling methods is to solve using By applying the mathematical model, we facilitate the solution of such issues in the future, as

well as the work of commanders and staffs planning combat operations.

2. APPLICATION OF A GROUP OF UNMANNED AERIAL VEHICLES OF THE SAME TYPE TO DIFFERENT TARGETS

In the armies of the developed countries of the world the production of UAVs and their use in combat conditions is highly preferred. These countries include the United States, Great Britain, Germany, France, the People's Republic of China and Israel. The UAVs produced by them are used in local wars and internal armed conflicts. However, the UAVs produced by the Turkish Defense Industry and the "Baykar" company have achieved great success in this direction in the last ten years. The same type of reconnaissance and strike drones were widely used in the anti-terrorist operations in Libya, Syria and northern Iraq, and in the Second Karabakh War. In some cases, military experts call this war a war won by the use of UAVs. Because the recent widespread use of UAVs has forced many countries to revise their military doctrine and military concept. Currently, UAVs are widely used in the Russian-Ukrainian war. The results obtained by the application of the group of unmanned aerial vehicles are in the focus of attention of military experts. In new-generation wars, the use of UAVs is preferred when one of

the sides does not have obvious success in ground operations. In modern wars, UAVs are considered as one of the main combat power elements. Analyzing and studying the results of wars, the armies of the developed countries of the world study the possibilities of fighting against UAVs and determine the tactics that meet the requirements.

A group of UAVs of the same type perform different tasks and are used against different targets. At this time, the targets destroyed in the offensive battle and the targets destroyed in the defensive battle differ according to their variety and importance.

It is known that the same type of drones under consideration carry four missiles per flight. It has cumulative, thermobaric and fragmentation missiles. Depending on the combat task being carried out and the nature of the targets planned to be destroyed, the command decides how many UAVs from the group of UAVs of the same type will be engaged and what type of missile they will be equipped with before their flight. Cumulative missiles are aimed at armored targets, fragmentation missiles at infantry and lightly armored targets, and thermobaric missiles at long-range firing points, elements of fortified areas, etc. Being applied. If we look at the Russian-Ukrainian war, we see that the list of targets destroyed by the use of UAVs is much wider. Energy blocks, electric power sources, water pumping stations, food supply blocks, etc., which ensure the life activity of

residential areas. includes. The possibilities of using UAVs in a wide range require the commander and headquarters to study their capabilities and application in detail, taking into account the tactical situation and the development scenario of activities during the planning and conduct of combat activities. In the event that the enemy's armored fighting techniques prevail, it is considered appropriate to strike with thermobaric missiles in the event that the enemy is preparing for a long-term defense. At this time, the UAVs are equipped with missiles according to the nature of the target, which is destroyed before the execution of the task. These activities are mostly carried out at the tactical and operational level. Different approaches to the application of IEDs are possible within the framework of activities in residential areas and in the depth of defense. First of all, the factors that hinder their application should be taken into account and favorable conditions for their application should be provided. At this time, one of the main conditions is gaining superiority in the air. Achieving air superiority requires, first of all, the destruction of air defense and air attack means in interaction with other means of destruction. Once this is achieved, UAVs can easily support formations involved in ground operations. According to the tactical episodes of the scenario of combat operations, the UAVs take into account the importance of the targets and destroy

them sequentially. At this time, possible scenarios obtained by the effective application of UAVs can be determined. Typical problems with the application of UAVs include:

technologically superior enemy forces that can be an obstacle to the use of UAVs (application of air defense means, especially in interaction with Radio Electronic Combat means);

- stable defense of the airspace and superiority on the side of the enemy;

- Protection of various types of targets destroyed by the application of UAVs using all natural and artificial means (creating a thick smoke and aerosol curtain by burning tires due to air defense equipment means and artificial means);

- of UAV (dense fog, strong wind, etc.).

- obtaining certain information about how combat activities will turn out in advance.

3. INVESTIGATION OF THE APPLICATION OF A GROUP OF UNMANNED AERIAL VEHICLES OF THE SAME TYPE TO DIFFERENT TARGETS

A strike group consisting of a number of UAVs armed with a group of unmanned aerial vehicles of the same type M was created. The combat kit m_1 of each UAVs includes number A_1, m_2 number A_2 and includes m_m a number A_m of types of missiles. k_1 number of H_1, k_2 number of H_2 and etc. has k_n number of H_n different goals. It is considered an urgent issue to pre-investigate the possibility of applying the anti-aircraft strike group against various targets in favorable and unfavorable conditions (table 1).

Table 1. Efficiency coefficients of the application of the unmanned aerial vehicle to various targets

Serial no	Unmanned aerial vehicle the means of fire he used	Under favorable conditions				In unfavorable conditions			
		H_1	H_2	...	H_n	H_1	H_2	...	H_n
1	A_1	p_{11}	p_{12}	...	p_{1n}	p_{11}	p_{12}	...	p_{1n}
2	A_2	p_{21}	p_{22}	...	p_{2n}	p_{21}	p_{22}	...	p_{2n}
...	...	...	...	...	...	...	...	...	...
m	A_m	p_{m1}	p_{m2}	...	p_{mn}	p_{m1}	p_{m2}	...	p_{mn}

Let's assume that the UAV m uses a number of different means of fire as a

means of fire, during combat operations against a number of different targets. n

x_{ij}- is the number of destroyed targets of the j −th type with the i- th missile

p_{ij} - are the efficiency coefficients of the application of the i- th missile to j th the type h_j target.

Then $p_{ij}.x_{ij}$ − the average value of the result expected from the application of the i- is missile to the target j− th of type h_j. Average value of targets destroyed if used during combat operations against all different m numbers of missiles with different numbers of targets n

$$MH(x) = \sum_{i=1}^{n}\sum_{j=1}^{m} p_{ij}\, x_{ij}$$

can.

Tere is,

The function $MH(x)$ the average number of destroyed targets during combat operations to against different targets n of missiles m means. This is the objective function of the problem.

Then it is required to find the optimal option so the at the maximum number of targets is hit. At the same time, it would be interesting to hit the minimum number of targets according to the most unfavorable situation. According to the given situation, the mathematical model of the problem is as follows:

The objective function

$$MH(x) = \sum_{i=1}^{m}\sum_{j=1}^{n} p_{ij}\, x_{ij} \rightarrow \max(min) \qquad (1)$$

Conditions of limitation

$$\sum_{j=1}^{n} x_{ij} = a_i, \qquad i = 1, 2, \ldots, m \qquad (2)$$

$$\sum_{i=1}^{m} x_{ij} = b_j, \qquad j = 1, 2, \ldots, n \qquad (3)$$

$$x_{ij} \geq 0 \qquad (4)$$

here

a_i- $i$type of means of destruction,

b_j and - $j$is the number of type -th target.

Suppose that p_{ij} values $i = 1, 2, ..., m; j = 1, 2, ..., n$ are of the efficiency coefficients, a_i - destruction and $b_j -$ targets are given.

The above data, solving problems (1) - (4) in favorable and unfavorable conditions x_{ij}, $i = 1, 2, ..., m; j = 1, 2, ..., n$ is possible to find the smallest and largest values of the function $MH(x)$ of the number of destroyed targets[3, 4, 5].

4. THE RESULT

Based on the results obtained in this way, the minimum and maximum number of targets destroyed during combat operations with missiles of the same type of UAVs group against targets such as tanks (armored targets), air defense equipment, infantry group, long-range firing point in favorable and unfavorable conditions. Before starting their activities can be determined in advance.

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THE ROLE OF GENDER-BASED ANALYSIS IN ENHANCING SOCIETAL SECURITY.
A CASE STUDY OF ROMANIA'S APPROACH TO COVID-19 PANDEMIC AND ITS IMPACT ON A SELECT NUMBER OF GENDER CATEGORIES

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Societal security has become nowadays an important pair of lenses for discussing identity in a multilayered fashion within the context of an enlarged security concept. The complexity deriving from that engenders the necessity to identify and use new tools for reliably defining communities and their specific identities in order to better understand how state-wise strategies and policies can raise security risks when disregarding those communities' needs and interests. In this respect, the goal of this article is to demonstrate the benefits of employing a gender based perspective in defining societal security. Hence, it focuses on the possible correlations that can be conceptually identified between societal security and gender perspective. Then, the article exemplifies how a gender based analysis can contribute to better societal security approaches by discussing Romania's strategic approach to the Covid-19 pandemics and the possible observations deriving from that.

Key words: *gender analysis, societal security, identity, risks, threats, vulnerabilities.*

1. INTRODUCTION

According to (Theiler, 2003) society is "the social unit that provides the primary locus of identification for its members." It has both an 'objective' dimension – language and customs – and a 'subjective' dimension – shared meanings and identifications ('we-feeling').[….]. Furthermore, the same author, defines societal security as "the perceived ability of an identity community to survive." From this perspective, the concept refers to "the sustainability, within acceptable conditions for evolution, of traditional patterns of language, culture, association, and religious

and national identity and custom' in a given society". (Theiler, 2003)

On the other hand, Buzan and Waever [1] link the concept of societal security with "the concepts of weak and strong state, as well as introducing the five aspects of security – military, political, economic, societal and ecological." (Chifu, p.2) In this respect, political security concerns the organizational stability of states, their systems of governance, and the ideologies that provide them with legitimacy and authority, whereas "Military security concerns the two-level interplay between the armed offensive capacity and the defensive capabilities of states and their perceptions of each other's intentions." Furthermore, economic security regards the level of access the state has to the resources, finance and markets necessary to sustain acceptable levels of welfare and state power. [2] Societal security concerns the sustainability of traditional patterns of language, culture, religion, national identity and customs. Last but not the least, environmental security regards the maintenance of the local and the planetary biosphere as the essential support system upon which all other human enterprises depend."

Another approach to societal security highlights that it is "associated with reduction of probability of undesirable phenomena occurrence and the reduction of risks associated with issues of survival, quality of life and national identity." Public security is "associated with the protection of life, health and property of citizens form risk of terrorist attacks." [3] According to Rhinard, M.,[4] societal security "refers to the ability of a society to function", its resilience, the capacity to face the crises and the attitude towards risk. Therefore, as Gierszewski, J., Piwowarski, J.[5], societal security is an important category of national security. Consequently, "Cooperation in military and civilian security matters becomes critical in a societal security approach, as do close links between the public and private sectors." (Rhinard, p.12)

All of the above considered, we reckon that Covid-19 has been the test for many countries in terms of their societal security, especially in areas like quality of life, identity, survival, state stability, to mention just, few. Consequently, by the case study we propose as to how Romania's overarching strategy for dealing with the Covid-19 pandemic impacted a select number of gender categories, we aim at highlighting the importance of using a wider array of data to inform policy-making and decisions in the field of societal security on its multiple levels: economic, political military, economic, environmental.

2. CASE STUDY: ROMANIA'S OVERARCHING STRATEGY FOR DEALING WITH THE COVID-19 PANDEMIC AND ITS IMPACT ON A SELECT NUMBER OF GENDER CATEGORIES

Based on the Cynefin framework we assess that the overarching strategy of Romania in relation with the Covid-19 pandemic was scaffolded. It started with a **best practices approach** between 22nd January - 26th February, namely before Covid-19 was declared a pandemic by the World Health Organization in March 2020. It was a strategy characteristic of simple and obvious environment (i.e. time tested approaches to containing health problems/diseases) and run by rigid constraints.

After WHO declared Covid-19 a pandemic, Romania employed a **good practices approach** where boundaries were defined and hence governing constraints were identified. The approach was specific for complicated environments in terms of **decision-making and coordinating** from the moment WHO declared Covid-19 a pandemic in March 2020 and until May 2020 [6]. This strategy was informed by the input of healthcare specialists and not only (for example joint committee of specialists had already been established to advise), people from the military were appointed to be in charge of managing hospitals and cities where the toll of Covid-19 was extremely high (for example the city of Suceava), or to run the vaccine campaign. The strategy was applied in a centralized manner: central administration monitored the evolution of the pandemic, whereas the entities at local level were enabled to implement the measures. Some of the most important decisions illustrating this type of strategy and impacting disadvantaged groups of people were related to the close down of schools, restriction of rights like freedom of movement, freedom to family and private life; home privacy; right to education; freedom of assembly; right to private property; right to strike; economic freedom by presidential decree.

The aforementioned strategy overlapped with an **emerging practices approach**, where a *probe-sense-respond* type of strategy employed by politicians in relation with **meaning making** for the same type of period. For example, in the case of vulnerable groups such as elderly people there were changes in decisions concerning permission to leave house between specific time-frames.

The main measures [7] taken by Romania as part of its overarching

good practices strategy which represent the guidelines for analyzing the impact of this strategy from a gender-based perspective were: self-isolation measures in case of having made contact with a Covid patient; forbidding the organization and conduct of public events; teleworking in all public and private institutions with the exception of those that were part of the public order, security and defense system; working in shifts where continuity of service was mandatory; closing schools (March 2020-June 2020) and the obligation to conduct full online education starting September 2020 and then only depending on the number of infections at local level in 2021; lockdown (March 15- May 2020).

2.1. How Romania's overarching strategy for COVID-19 affected individual groups: data analysis

The individual groups that we included as part of this randomized study include women, men, boys and girls differentiated by age, socio-economic features, ethnicity, various disabilities and accessibility needs. The table below provides a clear depiction of the categories chosen and represents the guiding line for discussing how the groups identified were impacted differently by the overall strategy for dealing with the health crisis.

Table 1. Categories of individual groups providing gender based data for the randomized study

	Categories of individual groups			
	different age groups	different socio-economic groups	different ethnic groups	people with various disabilities and accessibility needs
women	- working women 30-65 - retired women 65+	- single mothers	- immigrant women from Philippines	- women suffering from psychological disorders
men	- employed 30-65 - retired men 65+	- freelancers	- immigrant workers from Sri Lanka, Nepal	- men immobilized in bed (at home or in nursing homes)

| girls | - elementary school
- teenagers | - girls from rural areas with one or more younger siblings | - girls of Hungarian ethnicity from Harghita and Covasna counties | - girls with Down syndrome |
| boys | - elementary school
- teenagers | - boys in rural areas with parents working in agriculture | - boys of Hungarian ethnicity from Harghita and Covasna counties | - boys with autistic disorder |

2.1.1. Working women 30-65 of age and single mothers

For **women between 30 and 65** who had been employed before the outbreak of Covid-19 pandemic, the lockdown period generated two possible situations. On one hand, for the women working in the hotel and restaurants industry, the unemployment rate increased. In the case of such women, their socio-economic features, namely low income correlated with low to average educational background, also played a major role in diminishing their prospects of finding other jobs to secure their livelihood. That made them even more prone to becoming dependent on other people from within their family, to possible abuses and also to loneliness [8]. Inherently it became impossible for them to support their family needs and themselves. On the other hand, in the case of the women who managed to keep their jobs – and that was the case of women with high income and high education – there were two possible scenarios. Some of them had to work online on a day to day basis with negative consequences on their socialization and emotional needs, on one hand, and with a huge impact on their capacity to assure work-life balance while working from home on the other hand. In the case of those who had to work in shifts, as per ordnance provisions, their difficulties consisted in finding solutions to assure their dependents' needs (e.g. children staying at home and taking their courses online or commitments to elderly relatives). The situation was even more dramatic in the case of single mothers. Regardless of their income and education levels, finding financial means to support themselves and their family, or finding babysitters willing to take care of their children and also affording to pay for such services was one major obstacle.

As per data from 2018 [9], there are differences in terms of family obligations of women compared to men. Thus, 33.9% of women have dependents, whereas the percentage of men with dependents is slightly lower: 30.9%. The difference remains even when disaggregating the data for urban and rural areas: 31.7% men compared to 33. 3% women. That is a tell-tale indicator that for the women in the three categories discussed above the strategy employed at country level in order to contain the effects of Covid raised more difficulties.

2.1.2. Retired women 65+ and women suffering from psychological disorders

Women **aged 65+** and who were either pensioners or in the care of their family or specialized institutions were exposed to increased solitude as a result of lockdown period or restrictions concerning their whereabouts. Moreover, there was an increased threat to their mental health and self-sustainability given the restrictions at the beginning of the pandemics. In this respect, regardless of whether we focus on **men or women suffering from psychological disorders**, in Romania psychological disorders are not a condition that is widely acknowledged as requiring specialized care and treatment. More

often than not, people with psychological disorders, especially those coming from low income – low educational background families/communities, are taken care of by their families. In the worst case, some of those may end up being exploited for begging or are subject to abuse. In the case of Covid-19 specifically, there were instances when the loneliness generated by lockdown measures made some women diagnosed with psychological disorders no longer respond to treatment and be committed to specialized medical units. Unfortunately, the Covid restrictions, the insufficient number of beds in hospitals led to the necessity to discharge those women before full recovery, hence exposing them to relapses and their families to the burden of living with them with no medical assistance available for that [10]. When families could afford to pay for private care in specialized institutions, the Covid restrictions led to a lack of transparency and even accountability of those institutions towards the families of those women.

2.1.3. Employed men 30-65 of age

Statistically speaking, in Romania the employment rate for men is higher compared to women: 71,5% men compared to 54,4% women. The Covid 19 restrictions may have led to the following

impacts on the **men who were employed** at the time. Some of those men may have been in the situation to start working from home. In such a case, the main consequence for them was related to their capacity to separate work life from personal life and secure the necessary balance needed for a healthy life style. For those who had to go to work because of their line of work and worked in shifts, the pandemic restrictions might have raised difficulties in terms of their capacity to find the right adjustment strategies. For example, in case of married people, finding solutions along with their spouses as to how to secure the welfare of the children who had to study from home or of their dependents (e.g. elderly people or children with disabilities) might have required making difficult choices as to which of the spouses would stay at home and which would continue to work (with an impact on family income and possibly family unity) or juggling with the scheduling of spouses' shifts leading to stressful situations.

2.1.4. Retired men 65+

As for **retired men 65+**, according to statistics [11], men, and especially those of 65 and beyond register lower life expectancy rates compared to women of same age. Inherently, the Covid-19 pandemics has taken a heavier toll on men compared to women. For example, the average age for men reported as dead from Covid was 66.7 years, whereas in the case of women it totaled 69.2 years. [12] Furthermore, the general death rate among men was higher compared to women: 58.16% for men and 40.81% for women.

In our opinion, the impact on **freelancers** (e.g. actors, musicians) can be better understood in correlation with statistics that cover unemployment because in their case, considering their rather small number, statistics are difficult to find. Thus, the number of unemployed men in March in 2022 reached 410.000. The unemployment rate for men was 1.3 percentage points higher than for women in March, i.e. the unemployment rate for men rose to 5.1% and 3.8% for women compared to February. According to the Ministry of Labour and Social Protection, as of 30 April 2020, more than 725,000 individual employment contracts were suspended, with the largest number in the manufacturing industry- 181,000, followed by the wholesale and retail trade industry- 141,000 contracts, and the third largest number of suspended contracts in the hotel and restaurant industry. All of the above considered, we could assume that for freelancers the percentages of contracts suspended

or canceled during the Covid 19 pandemic was much higher, especially for those working in the arts and crafts industry. That most definitely had a huge impact on those men's possibility to sustain themselves and, as case may be - their families- financially speaking.

2.1.5. Men immobilized in bed (at home or in nursing homes)

Concerning the category of **men immobilized in bed (at home or in nursing homes),** it is difficult to find sex disaggregated statistics or any statistics at all concerning this category. However, the assumptions we can make are as follows. For this category of men, the Covid- 19 restrictions (e.g. lockdown, working in shifts for nurses/specialized personnel) along with the general feelings experienced by most Romanian people (fear of the unknown, fear for their own health) must have dramatically impacted how men immobilized in bed were taken care of. If they were under family care, the restrictions contributed to spending much more time along with other family members in the same house/apartment. That was not necessarily a positive aspect since needs like privacy, socialization were heavily impacting everybody's lifestyle and living on an ongoing basis with people with special needs may prove challenging. Even if the

families may have benefitted from specialized care, considering how overburdened the medical system in Romania was with Covid infections the specialized personnel may have chosen to cease the assistance on grounds like fear of transmitting the infection, huge workload and inherent stress. Specialized assistance may have also become more difficult to provide in specialized institutions for the same reasons. Consequently, the standards of care for those men may have dropped dramatically and they could have been exposed to developing anxiety, depression or they might have been neglected because essential medical resources had to be re-directed towards treating people diagnosed with Covid, to state just a few of the possible consequences.

2.1.6. Girls and boys in elementary school

In our opinion the Covid19 pandemic impacted most of the children who were either supposed to start elementary school or finish the last year of elementary school. For the first category, it was very difficult to properly meet their new colleagues and socialized with those, whereas for the latter transitioning from elementary school to secondary education must have proved equally difficult. Online education in Romania during the Covid 19 pandemic depended a lot on the

skills, commitment and willingness of the educators to keep up quality standards. The decisions as to how to run classes, what kind of instructional materials to use was initially a decentralized aspect and that led to a plethora of individual approaches to conducting online classes. We would surmise that those approaches did not necessarily meet the needs of the children - boys and girls. We would rather reckon that they were derived from the aforementioned variables that were related to each educator's knowledge and skills in using online tools, and also commitment and belief that online education can be conducted just as well as resident education.

Aspects like differences between boys and girls in acquiring knowledge and honing skills were not necessarily a priority. For example, in elementary school, girls are more proficient if the didactic activities are based on oral explanations and tasks, and dialogue. On the other hand, it is demonstrated that boys in elementary school perform better if they are exposed to practical activities, concrete examples and visual materials. Compared to girls, boys learn better when they move around, touch and use various objects. In elementary school girls perform better in writing and reading compared to boys. Girls' motor

skills allow them to work with small objects and they are better at activities that require precision in this area. Boys are better at coordinating their whole body so they are more inclined and better at sports that require open space/generous space [13].

All of the above considered, we can say that while girls in elementary school might have performed better given some of the defining features listed above compared to boys. However, focusing too much on making such assumptions and building on them may be detrimental to girls' development since, I would say, they also need to experience practical activities and need to learn by visualizing and touching. The reverse logic also applies to boys.

2.1.7. Girls and boys (teenagers)

The "Pupils' views on online education and the effects of isolation" conducted by Save the Children in the midst of the pandemic showed that tiredness, sadness, anger, boredom were often experienced by children, with primary school children and adolescents experiencing a stronger negative impact of isolation from other children their age. Four out of ten children, while using the Internet, experienced problems such as negative content, unwanted messages, viruses, fake news, and

one in three had disagreements with parents about Internet activity or time spent online [14]. Furthermore, during the pandemic period (March 2020 - March 2021), the counselling centres of the Save the Children Organization have taken in a total of 678 children and adolescents who have developed various emotional disorders, the majority of which developed in the psycho-social context. The analysis revealed that one child in three experienced anxiety and needed counselling and psycho-emotional support, with the percentage rising to more than 50% in the case of adolescents, going as far as extremely serious consequences, namely suicide attempts. And more than 90% of children who needed psychological therapy in the last year developed emotional disorders related to the pandemic context. There was also a general decrease in concentration in online classes, as well as in social skills and interactions. The inability to do outdoor activities and to go outside the home intensified anxiety-like behaviours. Lack of direct interactions with peer groups, increased screen time, the flood of emotions and the intensity of experiencing them affected the ability of emotional self-regulation among adolescents. In general, we can speak of a decrease in interest in school activities. In turn, parents

have experienced mental and emotional exhaustion. [15]

2.1.8. Girls from rural areas with one or more younger siblings and boys in rural areas with parents working in agriculture

Children in rural areas experienced problems with access to the Internet or to mobile devices, as it was the case for example, of 179 children in the eighth grade from Harghita County [16].

Furthermore, in the case of both boys and girls, the "man box" approach has led to many of the boys in school to contribute to their parents' efforts to sustain family needs by working in agriculture. Their involvement was all the more important since movement constraints made it difficult for their parents to secure their day-to-day livelihood. In the case of girls with younger siblings, and especially in the case of those girls whose mothers had already been unemployed, were made redundant or had to work from home, the latter had to bring their contribution to their families' welfare by taking care of the younger children or by sharing with their mothers the household chores.

2.1.9. Boys and girls of Hungarian ethnicity from Hargita and Covasna counties

Hargita and Covasna counties are inhabited by a large majority of

Hungarian ethnics (around 80% on average). The children in these counties speak only in Hungarian and are completely isolated from the use of the Romanian language which is the national language of Romania. Therefore, their only opportunities to remain integrated is either in these counties or in Hungarian speaking communities from Romania or abroad. These counties are also among the poorest in Romania [20], half of the villagers living below poverty level. The isolation during Covid-19, the conduct of classes online only led to a rapid dwindling of the chances for the boys and girls in these counties to remain integrated in their own communities, or to get a better chance outside those communities.

2.2. SHORT, MEDIUM AND LONG-TERM CONSEQUENCES ON INDIVIDUAL GROUPS AND SOCIETAL SYSTEMS: DATA INTERPRETATION

The lockdown decisions restricting freedom of movement, the decisions to shift to teleworking in some sectors, the decisions to switch to working in shifts or the decisions to transition to online education in the case of children did not necessarily ease the life of women who held a job at the time the Covid 19 pandemic, the life of single mothers, nor of employed men 30-65 of age. For those working from home, the positive aspect could have been that they were presented with opportunities for self-pacing and balancing personal and professional life, while pursuing long forgotten personal/professional projects. However, we should not forget that working from home had to be balanced in most cases with their children's requirement to study from home. Therefore, compromises that we are not aware to have been studied yet must have taken place in terms of work-life quality, level of stress, to mention just few. In this respect, we may surmise that those women experienced an increased need to maintain involvement in personal/professional projects whereas also fulfilling job related tasks. Furthermore, higher expectations of flexible work schedule if not of opportunities for tele-working and hence greater flexibility in exploring other employment opportunities matching their needs could have been part of the impact the Romanian strategy might have had on this group of women. In terms of the long-term impact on societal systems, we surmise that the following are greatly impacted: the labor sector, economy, family and child care services as a result of these categories' requirements for greater flexibility on behalf of employers requiring changes in labor laws,

possible brain drain requiring adjustment of business and government entities' way of conducting work, and requirements to maintain personal-professional balance and hence necessity for adaptable, flexible child care services.

Concerning the status of the people with various disabilities and accessibility needs (boys with autistic disorder and girls with Down syndrome), men immobilized in bed (at home or in nursing homes), or retired people, the Covid-19 pandemic demonstrated the vulnerabilities of societal functions. Thus, the good practices approach of the Romanian strategy for the period when Covid-19 was declared a pandemics instated a centralized approach in terms of re-directing the capabilities of hospitals and family doctors towards monitoring, diagnosing and treating Covid cases while instating telemedicine options for other categories of patients. However, telemedicine, in our opinion, was not necessarily an option for chronic or difficult cases. Moreover, we presume that early diagnosis and continuity of care for patients under treatment were endangered by a good practices approach, which, from a political standpoint, overlapped with a strategy directed at tackling complex environments, and hence adjusting the response based on the signals received from the media or from representatives of social society. In the latter case, we could say that people suffering from chronic diseases, or with various disability and accessibility needs did not necessarily have their voices heard loud and clear at top decision-making levels [21]. On short-term, in the case of these categories, there was an obvious mismatch between their needs for competent and on-time care and the the quality of opportunities offered (e.g. tele-working or the individual commitment of social care workers), while re-direction of medical resources for priority areas (e.g. Covid-19 cases) heavily impacted their access to proper care. That led on short to medium-term to increased financial needs as a result of these people experiencing a worsening in their health condition requiring more expensive treatment or care solutions. On long term we would not be remiss to state that a drastic decrease in the quality of life of these categories could be foreseen. As for the long-term impact we may say that the strategy chosen impacted the public health system, the health care system, families, as well as the social welfare system. The consequences consist in:

- Greater financial and infrastructure burden on families since the features of Romanian culture along with the

level of average income prevent people from seeking/finding specialized nurseries/health care solutions;

-Increased financial burden on state hospitals that need to provide specialized health care in the future to those people who could not be diagnosed on time or did not have access to health care services during the pandemic;

- increased requirements for social welfare system to provide for the basic needs of these people when families cannot afford to cover for their care.

The situations with which immigrant workers were confronted during Covid-19 expose also the lack of accountability of employers when it comes to assuring the workers their rights in full. Thus, in the case of immigrant workers from outside European economic area, the Covid-19 pandemic and lack of transparency on behalf of employers, led to the impossibility of these people to actually find solutions when confronted with abuses. The most immediate impact should they have made complaints to their working conditions, would have resulted in losing their right to work in Romania and hence incapacity to secure for families in their home country and poverty. Inappropriate working conditions, possible abuses on behalf of employers or the desire of these people to work in Western

countries could have presented them with higher exposure to human trafficking networks. Consequently, we believe that the societal functions most impacted by the case of workers from outside European economic area impacted government immigration offices, businesses, their families, but also overall Romanian society and its security. In terms of foreseeable consequences, we can identify:

- Requirements for streamlining bureaucracy possibly leading to more efficient and effective work within immigration offices;
- More thorough criminal investigation given terrorism as a threat worldwide;
- Profit on behalf of business owners and increase in GDP;
- Integration of immigrants within society fabric requiring multicultural and intercultural awareness initiatives.

In the case of boys and girls starting elementary school, and even in the case of children in rural areas or coming from minority groups, the Covid-19 period raised more difficulties for them to overcome than under normal circumstances. Also a heavier burden was placed on the shoulders of those children's parents or relatives in those situations when online education required access to technical resources, special technical skills, accessing Internet in what we would

call a "child proof manner", employing pedagogical skills and also resources such as printers. All those considered, the chances for children to remain connected to educational programs and achieve learning outcomes decreased during the Covid-19 pandemic. That is even more worrying if we take into account that more than a third of children in Romania (38.1%) are at risk of poverty or social exclusion. Therefore, the Covid-19 measures have increased the percentage of families in financial difficulty exposing them and their children to the associated risks of low living conditions, discrimination and social exclusion. In relation to that it is noteworthy that in Romania, early school leaving and non-attendance disproportionately affects disadvantaged groups of children; in 2018, 41.4% of disabled children either dropped out or did not attend school on a frequent basis; by comparison, 25.4% of children dropped out of school in rural areas, 14.9% in small towns and suburbs and only 4.2% in large cities. Furthermore, in January 2020, more than 275,000 children of compulsory school age (7-17 years) were not attending school, and for primary and secondary education as a whole, the dropout rate for 2018/2019 was 2.1%, which means approximately 35,300 pupils, an increase compared to previous years. The data above

indicate the high risks children not only of 7 years old, but all children that should be in school and for various reasons do not attend any educational program, or drop out are prone to exposure to human trafficking networks, to social exclusion and in the medium to long run to poverty.

3. CONCLUSIONS AND RECOMMENDATIONS

The measures taken by Romania during the Covid-19 pandemic can be summarized as follows in terms of how it affected different individual groups and then how it affected the societal level. The societal sectors, services and functions most affected and to be heavily influenced on long-term by the Covid-19 as a result of increased requirements for supplemental income, health care support, educational and training programs focusing on better societal and labor workforce integration of disadvantaged women, boys and girls at risk and men in need were: the health care system; the educational and training system; the social protection/welfare system; the legal and judicial system (labor laws); the security sector; the immigration system; the public-private partnerships, to mention just few. The impact outlined as part of this randomized study on various

gender categories also highlights a number of recommendations concerning how gender based analysis can enhance societal security.

First, it is essential that gender informed strategies with an impact on whole-of-nation security rely on tools that generate sex-disaggregated data. Those tools should work not only with general categories (i.e. men, women, boys, girls), but also with ethnicity of women and men, boys and girls (from various walks of life), socio-economic groups, various disabilities and access needs, age groups along with status and pay grade specific categories. In this respect, a wider scope of such data is required, since, as our qualitative research highlights, vulnerable categories are the ones least represented and visible and in times of crises their needs need to be also addressed in an equal and equitable manner Thus, establishing/applying an existing gender based analysis framework for future strategy formulation, along with gender informed decision-making at strategic levels would enable asking the right questions of the specialists who have access to data and information.

Second, as the interpretation of the data demonstrates, societal security relies on a wide number of societal functions and systems. Consequently, establishing an integrated/system based view or a hub of government, business, non-profit entities that have data relevant for gender based analysis and decision-making and assuring that the gathering of gender data is updated and sex-disaggregated becomes a necessity.

Last but not the least, consolidating the provision of societal services and functions from a gender based perspective requires the development, validation and implementation of a very short checklist for decision-makers that would integrate ethical values, along with the values of gender equality and equity in order to guide their decision-making process in crisis situations and not only.

Considering all of the above and taking into account the Sustainable Development Goals (SDGs), also known as the Global Goals, adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity, we claim that a more diverse perspective upon societal security as informed by a gender focused approach can sustain the SDG and contribute to the identification of tangible solutions. That is all the more important since the integrated outlook on the 17 SDGs leads to the acknowledgment that action in one area will affect outcomes in others, and that

development must balance social, economic and environmental sustainability. The SDGs are designed to end poverty, hunger, AIDS, and discrimination against women and girls. In this respect, creativity, knowhow, technology and financial resources from all of society are necessary to achieve the SDGs in every context.

ENDNOTES

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[21] That assumption is validated by a
previous situation when cancer patients
no longer had access to medicine
required for their treatment. In such a
case, non-formal networks of people
were ad-hoc established to procure such
medicine from abroad, while state
authorities bureaucratically delayed the
necessary decisions of facilitating those
patients' access to their life-sustaining
support.

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