White Paper

Technological, Operational & Civic Development Factors for Armenia's Security

Contributing Authors

David Akopyan
Arsen Arakelyan
Hayg Astourian
Berge Ayvazian
Arpie G. Balian
Anzhela Baltayan
Vasiliy Burov
Hriar Cabayan
Armen Danielian
Armen Der Kiureghian
Scott Fisher
Lev Freinkman
Robert Ghazaryan
Adam Kablanian
Nerses Kopalyan
Haykuhi Muradyan
Hagop Panossian
Artak Sahakyan

Editor

Hriar Cabayan

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Scope

This white paper builds on a previously published white paper entitled “Technology Development & Innovation in Armenia: Challenges and Opportunities over the Coming Decade.” It focuses on select technological, operational, and societal developmental factors that can enhance Armenia’s security over the coming decade.

Background

Given Armenia's limited financial resources compared to its primary adversary (Azerbaijan), it needs an approach that plays to its strengths. Armenia, including the diaspora, has a competitive advantage in training and unleashing a high-tech workforce. Furthermore, the relatively open and free Armenian information environment is an advantage. This paper focuses on areas that complement hard power and provide enhanced overall security.

Executive Summary

Hriar Cabayan

The sections below briefly summarize each of the contributions. The summaries are primarily meant to entice the reader to read the full chapters and have intentionally been kept short.

In "**Cyber Capacity Building in Armenia,**" Hayg Astourian and Adam Kablanian assert that Armenia stands at a critical juncture where advancing its cybersecurity capabilities could yield significant national security and economic development benefits. They go on to examine the considerable challenges the country faces and recommend a balanced focus on developing both offensive and defensive cybersecurity capabilities, leveraging Armenia's existing IT talent pool. They list positive developments in the field of cybersecurity in academia, grassroot organizations, cybersecurity companies, the Government and the military. They go on to list challenges the country faces such as a lack of experienced cybersecurity professionals and the paucity of institutions focusing on producing new cybersecurity experts.
They make several recommendations, including:

- Enhancing existing IT talent
- Encouraging teenagers to go into the field by developing and deploying a cybersecurity curriculum nationwide
- Paying careful attention to changes in the industry
- Encouraging investments in the private sector
- Encouraging positive developments across industry, education, and government

They conclude that enhancing the cybersecurity ecosystem can make a material impact on Armenia's economic development and in safeguarding its digital infrastructure.

In "**The Role of AI in Armenia's Economic Transformation,**" Berge Ayvazian and Artak Sahakyan state that Armenia is positioning itself to become a leader in the future of Generative AI in big data analytics, manufacturing, defense, and economics. The country is laying a robust foundation in AI leadership They add that the country's

startups are leveraging AI and ML to innovate across diverse sectors – robotics, biotech, life sciences, analytics, voice- and image-processing, AI cloud and other innovative technologies to create significant value-added products and services. Armenian companies are also creating highly targeted, well-trained GenAI algorithms linked to corporate data that have been carefully collected, curated and analyzed to yield good results. They state that Armenia's approach to AI development focusses on human-centric applications that solve real-world problems. Armenia has also seen in recent years a surge in global technology companies setting up their research and development offices and branches. They point to increasing recognition that Armenian national security, defense and military could significantly benefit from advanced AI and robotic technologies to help safeguard national security while minimizing human casualties.

They also list several headwinds that could affect this progress:

- Armenia is subject to geopolitical and geo-economic uncertainties that could affect foreign investment and diaspora engagement
- Armenia may also fail to retain many of its high skilled IT professionals and most innovative entrepreneurs

They argue that unless these trends are reversed, they could disrupt the sustainability and future growth potential of the Armenia ICT sector.

In "**Technologies for Energy Security of Armenia,**" Armen Danielian states upfront that energy security is one of the central questions with regards to Armenia's economic development, and observes that there isn't any single solution that can provide such high energy security. He states the primary approach to increasing energy security is through integration of local energy production technologies. He groups them into several categories and discusses each in detail:

- Nuclear power is considered critical for Armenia's national energy security
- Some renewables such as geothermal and hydropower can provide a certain degree of security, but their capacity is not sufficient for fully supplying baseload power in Armenia

- Other renewables, such as wind and solar, have considerable potential but do present issues in grid balancing due to their high variability and intermittency
- Smart grids, storage, and demand-side approaches all contribute to national energy security and facilitate integration of local renewable solutions
- Bioenergy and hydrogen can substitute for fossil fuels as transportation fuels, heating sources, and high temperature industrial applications, particularly in areas where electrification may prove difficult

He concludes by stating that Armenia is poised to capitalize on the global development of low-carbon technologies.

In "**Biosecurity and Public Health Threats,**" Arsen Arakelyan provides an overview of the global response to the COVID-19 pandemic, and then focuses on Armenia's response. He highlights several key limitations that should guide Armenia's future preparedness and response to public health emergencies and biological threats:

- The disruption of global supply chains during the pandemic had severe implications
- The country's limited manufacturing capacity left the country heavily dependent on international supply chains
- The underdevelopment and consequently minimal investment in R&D within the private biotech and pharmaceutical sectors

He makes the case that by learning from these lessons and taking proactive steps to address the gaps revealed by the pandemic, Armenia can build a more resilient health system capable of effectively managing future public health emergencies and biological threats. Specifically, the Armenian Government's Five-Year Development Program for the Pharmaceutical Industry addresses several defined objectives, including actions aimed at investments in new drug research. He observes the persistent threat of viral pandemics is a clear reminder that Armenia must remain vigilant and prepared. The country's ability to protect its population from such threats will depend on its investment in public health infrastructure, research capabilities, and international cooperation. By taking proactive measures now, Armenia can strengthen its defenses

against the inevitable future challenges posed by various pandemics. He goes on to advances ideas to strengthen Armenia's R&D capacity which will bring multiple benefits. These efforts will also reduce Armenia's dependency on external resources, enabling quicker and more effective responses to public health threats. He makes the case that investing in these infrastructures will stimulate the growth of Armenia's science and biotech R&D sectors, creating new business opportunities and fostering innovation. He notes, however, that we haven't yet learned our lessons from the pandemic. No government-level programs have been initiated so far to increase preparedness for future threats. He emphasizes the need to take immediate action, including the ones outlined in the article, to be ready next time. He concludes by stating these initiatives will greatly benefit educational programs by offering training opportunities for skilled researchers and specialists, helping to build a well-equipped workforce capable of addressing future challenges in public health and biotechnology.

In "**Networking for Security Assistance – The Role of the Diaspora and the Importance of Defense Diversification in Armenia's Security,**" Scott Fisher states upfront that Armenia has begun diversifying its defense suppliers and partners, as part of the shifting geopolitics of its near abroad. Given such a challenging geopolitical environment, Yerevan is left with no choice but to pursue defense diversification for the foreseeable future. He indicates that efforts to date include work with a wide range of countries and supranational organizations. Impressive diplomatic skills will be required to obtain needed security assistance. He observes that success in these efforts requires a range of activities and most importantly a clear, ongoing needs assessment. He observes that Armenia's government is clearly engaged in these activities already. The Diaspora can play a key role in two key areas:

1. Coordination role. He observes that any group(s) selected to manage this coordination role should have the experience, connections, and funding to succeed.

2. Tech-related role. He lists several examples such as cybersecurity, drones and counter-drone technology, information warfare, communications (including command and control related), and battlefield sensors.

He observes that an important aspect of this support is that much of it can be done remotely, He concludes that as Armenia navigates a complex and rapidly evolving security landscape, diversifying its defense partnerships and suppliers has become an imperative. By working together, the diaspora and Armenia's government, including the foreign and defense ministries, can help ensure the country's security and sovereignty in a challenging and unpredictable region.

In "**Information as a Tool for Deterring or Punishing Baku – How Armenia Can Target Azeri Weaknesses to Help Counter Baku's Military Power,**" Scott Fisher proposes a novel approach for Armenia to counter Azerbaijan's military advantage; namely; exploiting the latter's authoritarian weaknesses and its reliance on information control to maintain power. He proposes this can be done by leveraging open-source data collection and analysis and identifying/challenging Azerbaijan's censorship practices. Such activities can potentially result in undermining the ability of the regime to control the narrative and maintain power. He does identify the risks and challenges involved and goes on to propose a messaging campaign which requires advanced capabilities for open-source data collection and analysis. These will help identify key targets and knowledge of information media and a counter-censorship campaign. He observes that these potentially can offer Armenia a relatively quick and cost-effective means to deter and compete with Azerbaijan. He observes that by targeting Azerbaijan's authoritarian weaknesses, Armenia can gain a strategic advantage and create a more stable regional environment. He states this approach can also buy Armenia time to improve its military capabilities and reduce the military imbalance with Azerbaijan. He observes this is an area where Armenia, including the diaspora, appears to have a competitive advantage. He concludes by stating that if used properly, these tools can help return stability to the region while buying time for Armenia to improve the imbalance in military capabilities.

In "**Countering Disinformation Campaigns Against Armenia,**" Hriar Cabayan states upfront that sophisticated information/disinformation campaigns are part and parcel of the global geopolitical environment. These are employed to support geopolitical interests and can foment discord and create fissures within societies. He emphasizes that Armenia needs to develop an effective counter-messaging capability which needs

to be rapidly and effectively formulated and disseminated. He then lists and discusses several rapid interconnected “operational” and “technical” end-to-end capabilities that are needed to accomplish these objectives. Before embarking on such an overall approach, he lists several key technical questions that need to be addressed by appropriate experts and the steps that need to be considered. He states that for all this to happen, it will require a core of technically competent groups that gather and analyze the disinformation, assign one or more experts from a database to respond depending on the topic, and then disseminate the article to the appropriate media. He goes on to discuss approaches to enhance population resilience which is a key requirement in this threat space. He concludes that countering disinformation campaigns will require a long-term multi-disciplinary strategy with adequate capability to assess the effectiveness of the various tools and approaches.

In "**Historical falsifications carried out by Azerbaijan: a case study,**" Robert Ghazaryan and Haykuhi Muradyan argue that Azerbaijan has engaged in systematic falsification of historical narratives, particularly targeting Armenian history and heritage. This distortion, which intensified after the Soviet Union's collapse, has been used to legitimize Azerbaijan's aggressive policy against Armenians, especially in Artsakh (Nagorno-Karabakh). Between 2020 and 2023, Azerbaijan conducted ethnic cleansing in Artsakh, displacing more than 100,000 Armenians and raising concerns about the protection of Armenian cultural sites now under Azerbaijani control. Azerbaijan's actions seek to erase Armenian history, destabilize Armenia, and alter its history. Key points from their study include the following points:

- The Azerbaijani authorities continue to sponsor cultural genocide, with the erasure of Armenian heritage in the occupied territories
- These efforts have increased since the Soviet Union's collapse, with Azerbaijan using historical misrepresentation to legitimize its territorial claims
- From 2020 to 2023, Azerbaijan executed a plan of ethnic cleansing in Artsakh
- There is growing concern over the potential destruction of Armenian cultural sites now under Azerbaijani control

They conclude that it is crucial to recognize that these states are our neighbors and that we must endeavor to normalize relations with them. The question then becomes: How might we achieve this? What mechanisms or methods might we employ to do so? Undoubtedly, finding solutions that align with the paramount interests of the Armenian state are of crucial importance.

In "**Capability Requirements for Effective National Security Planning,**" Hriar Cabayan states upfront that effective strategy and planning for national security requires a comprehensive diagnosis of the nature of the geopolitical landscape, thus informing choices that in turn lead to more effective strategy formulation. This is increasingly becoming challenging because Interactive complexity in the geopolitical environment is accelerating. In this instance, the Caucasus is an example of such a complex environment that requires multi-disciplinary, mixed-method technical assessment approaches. Given this complex geostrategic environment, he states there is a need to enhance creativity and insight in the planning process. In this context, Armenia has some distinct advantages amongst others:

- Armenia, including the diaspora, has a competitive advantage in training and unleashing a higher-tech workforce
- The relatively open and free Armenian information environment is a relative advantage

He concludes that developing strategies to deal with these challenges will require multi-disciplinary, mixed-method technical assessment approaches for effective planning. He provides several examples in this domain such as leveraging the vast and highly effective network of SMEs from applicable agencies, policy centers, and academia both within Armenia and worldwide.

In "**Between Security, Technology, and Innovation: The Role of the Social Sciences in Strengthening Armenia's Security Architecture,"** Nerses Kopalyan's main thesis is summed up in his closing sentence, namely: "Armenia cannot have security without technological development and innovation; but at the same time, it also cannot address its security problems without the support of the social sciences." He states the marriage of technology and security will be a categorical failure in Armenia if the social

sciences are not integrated into the process. The article describes in detail the closed loop synergy between these three key elements: namely security, technology, and the social sciences. By way of background, he indicates that the synergy between the business and commercial sectors in accommodating the technology sector, while at the same time collaborating with the educational sector, have resulted in making Armenia competitive and strong in the Information Age. He goes on to address the following key questions:

1. What are the acute and specific security challenges that Armenia faces as it moves forward?

2. How can the social sciences support in finding answers and solutions to these challenges?

3. How can these findings be used by the technology sector to further enhance their contributions to Armenia's security?

He stresses the fact that National Security is not simply specific to physical security or hard power capabilities, and the role of the social sciences in offering solutions and guidance to the synchronization of technological strength with comprehensive security and resilience remains crucial. To this end Armenia cannot have security without technological development and innovation, but at the same time, it also cannot address its security problems without the support of the social sciences. As such Armenia lacks a cogent and well-developed model to translate its success in the technology realm to one that also enhances and strengthens its security.

He makes some key observations:

- The social sciences can exponentially strengthen and support technological development and innovation in Armenia by offering the tools, governance models, policy-making capabilities, and contours of functionality between technology and society

- The need to deepen, institutionalize, and systematize research capacities in political science in Armenia, while in parallel supporting pedagogy and professional

development, is extremely important. It is this field that produces government officials and civil servants, who are the two groups of people that will be guiding, supporting, and collaborating with the technology sector to strengthen Armenia's security architecture

- Armenia's security dilemma requires the integration of the following subfields into Armenia's security thinking: comprehensive security, intersocietal security, small state resilience, and hybrid warfare
- Contextual understanding of security situations must be understood on a continuum: low-intensity hybrid warfare to high-intensity interstate militarized disputes

He concludes that as a small democratic state functioning within a regional authoritarian orbit, Armenia faces a security dilemma that is more acute than the security dilemma inherent to most small states. As such, Armenia's situation remains more precarious. While the technological realm can proceed in attempting to answer such questions from the lens of its technical sphere of knowledge, it cannot, however, cogently address these questions without the support of the social sciences.

In "**From Crisis to Accelerated Growth: Armenia's Economic Transformation,**" David Akopyan, Vasiliy Burov, and Lev Freinkman observe that Armenia's recent economic growth acceleration is largely driven by improvements in economic fundamentals that create a better climate to support robust growth over the medium term. They go on to say since the 2018 revolution, Armenia's growth model has become more sustainable and inclusive. They focus on two developments to explain this trend:

1. The 2018 revolution brought economic freedom by dismantling oligarchic controls over business formation and growth
2. The new role of the high-tech sector which has reached a critical size and has advanced to a new stage

Then, examine the next phase and observe:

- Armenian tech companies already have a sizable footprint in several fast-growing market niches and are well integrated in global value chains
- There is a promising window of opportunity for Armenia. However, seizing it requires a more energetic and coordinated action by Armenian politicians and the global Armenian elites

They observe that so far high growth has occurred practically on its own, without much government contribution. However, for current trends to continue, Armenia needs to develop a state industrial policy, build new institutions, and expand participation in local, regional, and global partnerships. In this vein, comprehensive public administration and judicial reforms are necessary to ensure that the state can perform its core economic functions. They go on to argue that the country needs a transition to strategic and consultative decision-making, which so far has not been part of the governance tradition. They conclude by stating If Armenia plays its cards right, it could join the ranks of successful countries whose economic success is built on competitive advantages in the technology sector. While luck and international goodwill would be helpful, the real key to success lies in intelligent policy choices and disciplined execution by Armenian elites.

In **"Armenian Women as Technology Entrepreneurs,"** Arpie Balian quotes an Armenian entrepreneur who captures a key thesis of her article: to further women's participation in a more inclusive and diverse IT business sector, "We need more women mentors and role models to inspire the next generation". Balian states that the benefits of modernization and digitalization are not derived easily. Women across the world and especially in the developing world (including Armenia) face multiple obstacles they must overcome to succeed in the digital economy. Despite these challenges, women entrepreneurs (including those in Armenia) have begun to join digital platforms and make concerted efforts to carve out and expand their presence in the male-dominated IT sector. To overcome these challenges would require attention and effort by the government of Armenia and the private sector. Several of Balian's observations are based on surveys she conducted with Armenian women interested in, or studying to enter the technology sector. Her main findings are summarized below.

Women oriented strategies and observations

- Women in Armenia are more collaborative and compassionate than men, which are qualities that are particularly important leadership characteristics
- Gender roles for women in Armenia are changing in a few major cities where female participation in business is viewed more constructively.
- Balian recommends adopting a strategy of infrastructure support that prioritizes attracting women into technological entrepreneurship, and creating an environment conducive to supporting women's technological entrepreneurship

Role of the Government

- The government of Armenia must move faster towards enabling an environment where private businesses as well as community-based and non-profit organizations increase their interest in technological issues and are attracted to assuming a greater role in empowering women
- There is a need to strengthen State-sponsored programs directed at growing the technological knowhow of women and endorse their leadership in technological entrepreneurship
- The government should assume the role as coalition builder among public, private, and nonprofit agencies to collectively pursue a shared policy agenda to empower women
- Individual level governmental agencies could help drive a culture of entrepreneurship by raising technological knowhow among women by way of boosting their entrepreneurial skills and availing them startup incentives
- Armenia's legal framework and policy considerations could be improved to create the necessary infrastructure while creating incentives that elevate women's interest in technological entrepreneurship

- There is a need for training and retraining state employees in various topics of significance to technological development paying particular attention to circumventing male domination in these courses
- The government could foster the growth of the entrepreneurial ecosystem, paying close attention to advancing the involvement of women entrepreneurs in development
- The government must get engaged in women's entrepreneurial initiatives so as to magnify and extend the scale of their impact more broadly through access to state institutions and adoption of policies that increase state support and facilitate entrepreneurship

Role of the Private Sector

- Private sector involvement using various models that are innovative, participatory, and have built-in components for encouraging women in business
- Public and private sector organizations in Armenia must pay increased attention to increasing women's engagement in the economy as technology entrepreneurs

In "**An Armenian Woman's Experience in the High-Tech Sector,**" Anzhela Baltayan describes in detail the uphill battles and the headwinds she faced as she established her leadership role in Armenia's high-tech sector. She recounts her journey in the third person to better engage the reader. She first focuses on the challenges Armenia faces in developing a robust high-tech sector and makes the case that this sector is also about empowering individuals, particularly women, who are often underrepresented. She describes her journey as a testament to the resilience and potential of Armenian women in general. Anzhela states, *"Empowering women in tech is not just a matter of fairness; it's crucial for Armenia's national interests,"* underscoring the need for inclusivity and diversity in technology.

Her professional journey illustrates systemic challenges for women in tech and the need for a more inclusive environment to unlock their full potential. The sector, traditionally dominated by men, presents barriers such as gender bias, a lack of female

role models, and specific cultural expectations in Armenia that discourage women from pursuing tech careers. Such societal norms and stereotypes can limit opportunities for women and hinder their professional advancement. Under her leadership, the Gyumri Development Laboratory Foundation has become a cornerstone of technological innovation and education in Armenia. She lists several high-tech projects that address national security challenges and describes several initiatives that bring about significant community empowerment, leveraging technology to improve the lives of local residents. These exemplify her commitment to integrating technological innovation with community empowerment.

She also describes several efforts in mentorship and female empowerment, such as promoting gender diversity and strengthening the tech ecosystem. Her vision extends beyond Armenia, advocating for global efforts to increase female participation in tech through better representation and STEM education, setting a blueprint for other countries facing similar challenges. She hopes her leadership and dedication serve as an inspiration for future generations of women in tech, thus paving the way for a more inclusive and prosperous Armenia.

In **“The Role of Academic Institutions in Advancing the Technology Sector in Armenia,”** Armen Der Kiureghian focuses on the key role that academic institutions in Armenia play in advancing the technology sector and in preparing the needed manpower. He discusses the types of education and training that are needed, the skill sets that are critical in advancing this sector, and the types of technology advancements that are desirable. He points out that the needs in this domain are diverse and multi-pronged. There is a need for workers who produce the products offered by this sector and there is a need for innovators and entrepreneurs who create new ventures and products. In between, there is a need for managers who can lead the workers and assure profitability of the products and new ventures. To achieve these goals, every segment of the Armenian educational system has a role to play. He goes on to say that because of the current landlocked geopolitical conditions Armenia finds itself in, Information Technologies (IT) have become a dominant domain. Work in IT does not require physical transportation of goods and much of it can be done through electronic communication. He points out that currently there are two types of IT

companies in Armenia: Those that are branches of international (mostly American) companies. These usually offer limited opportunities for innovation and advancement. There are also tens of successful home-grown companies and thousands of aspiring small startups. He points out that education has a critical role in preparing the needed manpower for the technology industry and, indeed, for any creative and productive venture. He stresses that university-level education should aim at preparing citizens with broad as well as specialized knowledge, coupled with skills for inquiry, judgment, and communication, as well as life-long learning. He discusses the attributes and limitations of several academic institutions and the headwinds they face. He identifies areas that require improvement such as the needed reforms in training, certification, and better salaries for schoolteachers. Here, specific interventions and investments by the Armenian government are essential. He concludes by drawing attention to a recent group of American-Armenian academics who advocate for establishing a foundation to facilitate and support collaboration among Armenian and American researchers in science and technology fields. He states that such collaboration with international colleagues would be of extremely high value in advancing the level of science and technology in Armenia. Currently, efforts are underway to establish this foundation with support from the Armenian and US governments.

In **"The Role of the Diaspora in Advancing the Technology Sector in Armenia,"** Hagop Panossian states upfront that Armenia has a growing information and communications technology (ICT) sector which has come about through sound macroeconomic management. He stresses that the government of Armenia has an active role to play in supporting the further development of this sector, including:

- Utilizing Diaspora expertise and capacity-building capabilities and putting in place mechanisms for joint projects
- Enhancing connectivity by promoting trade and Foreign Direct Investment
- Developing the right environment for mutual respect including two-way trust and understanding

He also identifies various ways the Government can engage the diaspora in such higher value-added activities such as:

- Providing support for the sector and relationships with large multinational companies as part of global value chains
- Expanding the reform momentum
- Addressing the critical bureaucratic, legal and practical bottlenecks to create more jobs
- Completing the re-evaluation of methodologies, approaches, policies, and efficient and effective planning for highly beneficial improvement of cooperation and co-participation
- Expanding well-planned, fine-tuned approaches with more transparent communication and transactions with each of the diverse Armenian communities found around the world

He then turns his discussion to the Diaspora, pointing out that its experts have played a significant role in this endeavor either as co-organizers, participants, or financial backers. He observes there is still a vast untapped potential in the value the Diaspora can bring to the science and research ecosystem in Armenia, and points out that the Diaspora's scientific community excels in quality and performance on a global level. As such, there is a need to set up a system to be able to tap into this highly important and useful resource. He observes that Armenia's success in these fields is enhanced if there is significantly higher Diaspora participation. He lists various ways the Diaspora can do so, such as investment, knowledge transfer, networking, advocacy, collaboration, enhancing the educational system, entrepreneurship, and policy influence.

He goes on to point out however, the gaps between Armenia and the major diasporas in various countries. These can be broken down to operational culture, variations in professionalism, and mutual and comprehensive trust. To close the gap, he proposes several approaches:

- Establish closer communication and cooperation with diasporan experts and investors

- Evaluate the existing potential of every diasporan community through thorough research about the capacity, capabilities, and practical experiences available in every community
- Encourage firms in Armenia to branch out to activities that are catalyzed by emerging technologies in which also diasporan experts can play a part

He concludes by listing numerous ways Diaspora experts can be motivated to contribute to the scientific and technological development of Armenia, such as: Building strong networks, participating in collaborative projects, government support, professional development, partnerships with Diaspora organizations, and establishing long-term engagement.

Cyber Capacity Building in Armenia

Hayg Astourian and Adam Kablanian

Introduction

Armenia stands at a critical juncture where advancing its cybersecurity capabilities could yield significant national security and economic development benefits. The country faces considerable challenges, including a small talent pool, limited leadership experience in cybersecurity, the specialized nature of the field, the difficulties inherent in developing a new sector, and the need for a plan to build capability in the space.

Given the limited resources available, strategic prioritization is essential. This paper recommends a balanced focus on developing both offensive and defensive cybersecurity capabilities, leveraging Armenia's existing IT talent pool, and promoting education and training from a young age, by leveraging TUMO's nationwide network.

S-unik Venture Capital Fund and TUMO have partnered on this effort. S-unik VC Fund is actively fundraising to create the TUMO cybersecurity educational program, which would add cybersecurity education to the core TUMO education portfolio. When this project is successful, every TUMO learner in Armenia (25,000+ currently and growing) would have access to new cybersecurity self-learning activities and in-person workshops taught by cybersecurity industry professionals.

This paper will explore the importance of cybersecurity for economic development and national security, recent positive developments, challenges facing Armenia, and recommendations to build cyber capacity.

Economic Development

There is a growing demand for cybersecurity professionals. According to the National Institute of Standards and Technology, there is a shortage of 2.7 million cybersecurity professionals world-wide. In the USA alone, it is 714,000 compared to the 1 million currently working in the field (National Institute of Standards and Technology, 2022).

As the global trend of digital transformation continues, this field will only be more in demand. Indeed, as more sensitive data is collected (Artificial Intelligence, Big Data,

Internet of Things and Digitization), the importance of security will continue to grow. Like other IT work, this work can be done as a service or as a staff member for remote companies, bringing new cash flows to Armenia. Ideally, it is done inside of product companies based in Armenia.

Looking more broadly at the cybersecurity market, in 2017, Gartner forecast the market would grow to $86.4 B globally. In 2021, Gartner forecast global spending on security and risk management to grow 12% to $150 B, with $72.5 B spent on security services (Gartner, 2021).

Armenia's challenging security situation can become a competitive advantage in this market, as advanced threats target Armenia (Radio Free Europe/Radio Liberty, 2021). These threats can be detected, digested into intelligence and then sold abroad to other governments and institutions. The hardened defenses created to protect Armenia can also be productized and sold. This model of productizing insights and tools used for national security purposes, particularly offensive cybersecurity, has been successfully demonstrated by Israel, where many of their unicorn cybersecurity companies are founded by former members of Unit 8200.

Strengthening cybersecurity capacity is also a key step in continuing the growth of the domestic IT industry. Legislation and compliance frameworks requiring cybersecurity expertise are growing hurdles to sell to developed countries in the EU and to the USA. Examples include GDPR, CCPA, PCI, SOC2, and many other frameworks, with some related to artificial intelligence. For example, there are few firms within Armenia that can do compliance audits for GDPR.

National Security

Computer hacking is an effective way to steal secret information or disrupt critical operations. For Armenia, such secret information can allow it to navigate the plans of its more powerful neighbors with less risk. This same information can sway public opinion in information campaigns or demoralize adversaries using hybrid warfare (Swaine, 2018).

Armenia's vulnerability and reliance on international norms for its security may make offensive security risky to use in the short term. Collaboration with the international community can also be a good source of security and a powerful input to developing Armenia's cyber capabilities. Thus, the offensive uses of cybersecurity should be balanced with the defensive and the broader policies of the state.

Unfortunately, Armenia is currently severely vulnerable in the cyber domain (Papyan, 2021). In 2020, Armenia experienced numerous devastating breaches, resulting in the leakage of extremely sensitive data during the war. There is little public reason to believe its cybersecurity has significantly improved.

One must also consider that national security strategic sectors such as domestic defense production require cybersecurity to maintain full effectiveness. Otherwise, one might find that due to a software vulnerability, the produced equipment may fail when most needed, or the adversary may already have deployed an appropriate counter system. The nascent domestic defense industry, mostly started after 2020, needs strong cybersecurity to protect its products and in turn Armenia.

Of course, cybersecurity also has a role to play in counter intelligence. Most of those Armenians recently arrested for espionage were found to have been lured using social media, after all (Radio Free Europe/Radio Liberty, 2022).

With appropriate investment and execution, Armenia has the opportunity to improve its cyber capabilities, national security and economy. Before diving into the challenges and recommendations for doing so, it's worth surveying recent positive developments in the local ecosystem.

Positive Developments

At the university level, the establishment of a Master of Cybersecurity degree at the French University of Armenia, as well as multiple advanced trainings in cybersecurity led by French-Armenian experts, have been welcome advancements.

Grassroots organizations such as CyberHub and ArmSec have made leading contributions to the ecosystem by organizing free talks, hacking competitions, and training.

There is also a burgeoning scene of moderately successful cybersecurity companies, notably Hexens, Illuria, Humanize, and RedRays.

In government, a new agency incubating inside the Central Bank has been taking on the vital work of protecting Armenia's critical infrastructure. This agency, the Information Systems Agency of Armenia (ISAA) has been leading much of the effort around cybersecurity capacity building. The establishment of a new foreign intelligence agency also creates opportunities for new and innovative approaches to signals intelligence.

In the military, the Foundation for Armenian Science and Technology and the Ministry of Defense have established and organized a unit modeled after Unit 8200.

Although there are bright spots, serious challenges remain, requiring a strategic approach.

Challenges

1. The primary challenge facing Armenia is its lack of experienced cybersecurity professionals. The 20 to 40 it does have could be better organized, with few notable exceptions.

2. There are no institutions focused on producing new cybersecurity experts.

3. The specialized nature of cybersecurity aggravates this problem further, since it requires expertise in at least one other area, such at networking, system administration or software engineering. There is no "simple" bootcamp solution for cybersecurity. Instead, a talent pipeline must be built from the earliest stages to the most advanced stages. A positive view of this is that improvements in the quality of general IT education will raise the tide for cybersecurity as well, and vice versa.

4. There is limited senior leadership capacity in Armenia. Making systemic change requires experienced leaders who can establish trust across many segments of the country, such as government, education and industry. They must create political will, manage stakeholders and have excellent execution skills to deliver results. In Armenia, this is rare and difficult

Given the limited capacity and resources available, the challenges to changing this status quo can only be overcome with a strategic approach. We cannot afford to waste energy or resources on low-leverage or tactical efforts.

Recommendations

To address the aforementioned challenges, Armenia should build the professionals and ecosystem it needs.

1. For near-term impact, the priority should be upskilling existing IT talent with a focus on cyber defense, where most of the jobs are. The immediacy of impact, the specialized nature of cyber, and the existence of a fairly successful IT industry in Armenia make this an attractive option.

Certifications such as the Offensive Security Certified Professional (OSCP) are well-regarded internationally, fully remote and of high quality. Although this is an offensive certification, knowledge of what is possible can allow defenders to prioritize and advocate inside their organizations in a grounded manner. Other online educational programs should also be thoroughly vetted.

These professionals can then be leveraged for educational programs to “lower the ladder” to the next generations.

2. In parallel, a talent funnel must be created starting from the teenage years, through to universities, and most importantly to sustainable work. In particular, TUMO can be a powerful lever for creating a culture of cybersecurity, rudimentary skills and the top-of-funnel for cyber careers. Based on the cybersecurity learning workshops and hacking competitions organized at TUMO, teenagers are interested in learning more about this field.

TUMO is actively fundraising to expand its program from one-off events to the core curriculum, which would be taught via its platform across all of Armenia. S-unik VC Fund is partnering with TUMO to lead the fundraising for this critical effort, which is aiming to raise $1.8 million dollars.

Offensive security is a natural choice for teenagers at the top of the funnel, given its engaging nature. It is an exciting entry point, which is valuable for most IT professionals to learn about, at least for gaining a security mindset.

3. Careful attention should be paid to changes in the industry, such as the new role of AI-driven automation for penetration testing (see XBOW and Method Security). Many entry-level roles are at risk of automation, including analyst roles.

4. To create the greatest impact and sustainable careers in cybersecurity, more cybersecurity products should be developed in Armenia. This must be coupled with appropriate legal frameworks encouraging investment. Efforts should be made to work with venture capitalists and angel investors to understand if they invest in cybersecurity companies and what their experience has been.

5. The positive developments across industry, education and government should be encouraged, as they have already shown results and involve the talent base needed to kickstart the changes outlined in this paper.

6. Finally, this kind of broad and deep coordination would benefit from formal mechanisms involving representatives from relevant stakeholders. The ISAA kicked off this process with a workshop in 2023. This effort should be continued on a regular cadence.

Conclusion

There are many hurdles and much to do. Nonetheless, the work is necessary to protect Armenia’s national interests, elevate its IT industry and further develop its economy. With a strategic and collaborative approach, cultivating the cybersecurity ecosystem can make a material impact on Armenia's future. Now is the time to take action.

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Role of AI in Armenia's Economic Transformation:

Armenia's Ascent to Global Tech Leadership

Berge Ayvazian and Artak Sahakyan

In the heart of the Caucasus, a small nation is making big waves in the world of artificial intelligence. Armenia, a country of just three million people, is positioning itself to become a global leader in AI. This isn't just a dream – it's a rapidly unfolding reality. As we stand on the brink of an AI-driven future, the stakes couldn't be higher.

PricewaterhouseCoopers (PwC) predicts AI will inject over $15 trillion into the global economy by 2030, which is more than the current output of China and India combined. However, we are likely to hit this milestone even sooner based on these early indicators.

- The Global AI Infrastructure Market is forecast to grow at a CAGR of 30.4% from USD 35.42 billion in 2023 to USD 460.5 Billion by 2033, largely driven by demand for Generative AI solutions.
- Worldwide Enterprises Spending on Generative AI solutions will more than double by 2028 when it is expected to reach $632 billion, according to IDC.
- Generative AI helps secure competitive advantage across multiple industry sectors.
- The initial beneficiaries include Nvidea, Google, Microsoft Azure, Amazon AWS, Oracle, HP Enterprise, IBM and Alibaba.

Generative AI Tech is the next step in software, where deep learning models can collaborate with humans to generate new content and ideas and unlock a new era of human creativity. Many of the Largest Companies and Startups have embraced Generative AI to create new product initiatives and leverage new opportunities for profitable growth. Companies are using Gen AI for Innovation and AI-powered Natural Language Algorithms to create new code, images, text, simulations, video and audio content. AI Can Also Unlock the Potential for Vertical SaaS Investment, providing specialized features and capabilities tailored to specific industries. The message is

clear: adapt or perish. In the coming decade, businesses will either harness AI's power or fade into obsolescence.

The global tech landscape includes hundreds of Generative AI Startups that have attracted billions in venture capital, including Unicorns – privately held startups value at more than $1 Billion. Many startup companies have embraced Generative AI to increase worker productivity, create new product initiatives and leverage new opportunities for profitable growth. Ultimately, Gen AI will create more jobs than it will render redundant. It will just be necessary for the workforce to be retrained and use AI in a different way.

Yet, as with any technological revolution, concerns loom large. Many tech experts warn of an AI arms race, and top U.S. officials are concerned about highly targeted deepfake videos, disinformation campaigns and other AI-related threats have prompted global action. Countries face many of the same choices regarding AI. The U.S. has issued a sweeping executive order on AI oversight, aiming to foster safe, secure, and trustworthy AI development. Meanwhile, the EU has introduced the AI Act, the world's first comprehensive AI legal framework emphasizing human intervention.

Armenia's AI-powered future

Amidst this global backdrop, Armenia is carving out its niche and is already on the path to becoming a Global Leader in the future of Generative AI in big data analytics, manufacturing, defense, and economics. The country's startups are leveraging AI and ML to innovate across diverse sectors – robotics, biotech, life sciences, analytics, voice and image processing, AI cloud and other innovative technologies to create significant value-add products and services. The numbers speak volumes. In 2023 alone, 24 Armenian startups attracted a staggering $216 million in investments. Companies like Picsart, ServiceTitan, SuperAnnotate, Cognaize, Krisp, Netris, Gecko Robotics, Renderforest and Hercules AI are becoming synonymous with Armenian AI excellence.

As Armenia races towards AI leadership, it is crucial to remember that startups that use Gen AI most effectively within Ethical Limits will be rewarded the most. the goal of AI isn't to replace humans, but to augment our capabilities. Under the "Armenian AI"

brand, the source of information for GenAI doesn't have to be the Open Web. Armenian companies are creating highly targeted, well-trained GenAI algorithms linked to corporate data that have been carefully collected, curated and analyzed to yield good results. The Armenian approach to AI development embraces this philosophy, focusing on human-centric applications that solve real-world problems.

But Armenia's AI ambitions extend beyond startup success. The country is laying a robust foundation for AI leadership:

- NVIDIA, a global leader in AI computing, has opened an R&D center in Armenia.
- The National Supercomputer Center, housing the first AI-enabled supercomputer in EU Eastern Partnership countries, has launched in Engineering City.
- Yerevan State University now hosts the Center of Intelligent Computing, dedicated to cutting-edge AI research.
- Armenia is also investing in the next generation of STEM, ICT and AI education and training through innovative programs such as UATE ARMATH, Tumo Center and FAST Generation AI.

These developments aren't just impressive – they are transformative. They signal Armenia's commitment to becoming a global AI powerhouse, a vision echoed in a recent World Bank report highlighting the country's high-tech potential. As a prominent technological hub in the region, Armenia has seen a surge in global technology companies setting up their research and development offices and branches in recent years. Armenia has firmly positioned itself as a tech hub on the global technology map and its role as a global AI leader are being recognized. The Armenian information and communication (ICT) sector has been growing at 20 percent annually, driven in part by companies relocating from Russia and the arrival of thousands of new foreign high-skilled IT workers following Russia's further invasion of Ukraine.

According to Armenia's Statistical Committee, the country's gross domestic product (GDP) increased by 6.4% in the second quarter of 2024 compared to the same period in 2023 and GDP reached approximately $5.8 billion in nominal terms. However,

preliminary data indicates the ICT sector growth declined by 14.1% in May 2024, and some former government officials have expressed concern that Armenia is subject to geopolitical and geo-economic uncertainties that could affect foreign investment and diaspora engagement. Armenia may also fail to retain many of its high skilled IT professionals and most innovative entrepreneurs. Unless these trends a quickly reversed, this could disrupt the sustainability and future growth potential of the Armenia ICT sector.

In a world increasingly shaped by artificial intelligence, Armenia is proving that size doesn't matter. With innovation, determination, and a clear vision, this small nation is poised to make a big impact on the global AI stage. Although most of this activity has focused on the enterprise and commercial sectors, there is also an increasing recognition that Armenian national security, defense and military could significantly benefit from advanced AI and robotic technologies to help safeguard national security while minimizing human casualties. Several promising Armenian companies are now leveraging the power of AI and other leading-edge technologies to develop smart drones, robust video analytics, threat detection, command/control, strategic decision-making platforms, and cybersecurity solutions.

The World Innovation, Technology and Services Alliance (WITSA) has selected Armenia to host the World Congress on Innovation and Technology (WCIT) from October 4 -7, 2024. Under the theme “The Power of Mind: AI Beyond Limits, Within Ethics,” WCIT 2024 will feature a high-level Congress program, B2B meetings, the DigiTec Epo, WITSA World Cup for scaleups, innovation showcases, business presentations, workshops, and more. WCIT 2024 is the largest congress for technology innovators and entrepreneurs and will serve as a global platform to amplify the impact of Armenian information technologies, emphasizing the importance of applied sciences, investments, and presence across diverse regions and economies.

Technologies for Energy Security of Armenia

Armen Danielian

Introduction

Energy security is one of the central questions with regards to Armenia's economic development. The country depends heavily on imports of primary fuels, and the options for supply of natural gas (in any substantial amounts) are currently limited to Russia and Iran. Two-thirds of total primary energy supply is imported (IEA 2022, p 24), - a number that would be yet considerably higher if one included uranium imports as well.[1] Geopolitical and economic factors have shaped Armenia's energy systems, and the degree of energy security and independence that the country will achieve in the next decade or two will undoubtedly affect its political and economic capacities in return. In light of this, Armenia benefits from the global development of low-carbon energy technologies, which can serve the dual purpose of enhancing the country's energy resilience and reducing emissions. This section reviews key technology categories in the energy sector, the development and integration of which can support Armenia's energy security. It mainly provides an overview of domestic energy sources, followed by shorter reviews of complementary and auxiliary solutions. For a broader discussion of these issues, the reader is particularly advised to look into *Armenia 2022 Energy Policy Review (IEA, 2022)* and *Armenia's Energy Independence Roadmap (FAST, 2024)*.

Local Energy Production

The primary approach to increasing energy security is through integration of local energy production technologies.[2] We may divide these into three groups - the well-developed sources of energy in Armenia, the ones developing recently, and the yet untapped options.

In the first group are hydropower and, with some caveats, nuclear power. Hydropower HPPs at a cumulative 380 MWs. Despite relatively large capacities - for comparison,

[1] Nuclear energy is, according to widespread international practice, considered a local energy source, despite fuel itself being imported. See the discussion on nuclear in the following section.
[2] Diversification of suppliers is another approach; however, in our case this appears to be primarily subject to geopolitical analysis as opposed to technological one.

Armenia's peak power consumption is currently at around 1200 MW, - hydropower use is restrained by two factors. Firstly, environmental concerns, in particular over water level in lake Sevan, limit the actual power generation by the said cascade. Secondly, varying levels of precipitation during the year result in high seasonal variability of effectively available hydropower resources. The combination of these two factors renders hydropower unreliable as a baseload power supply in Armenia, in contrast to countries like Georgia, Switzerland, or Norway. While some capacity for additional hydropower plants construction remains untapped, this technology has limited contribution to energy security of Armenia due to above mentioned issues.

In the absence of abundant hydropower resources, the only *low-carbon* baseload power supply source in Armenia is currently nuclear power. Metsamor power plant, originally built with two reactors, was shut down following the Spitak earthquake, with one 407.5 MW reactor restarted in 1995 amidst concerns over energy security. Despite imported uranium fuel, nuclear power is considered a domestic source of energy according to international practice. The longer operating fuel cycles of nuclear power plants reduce their reliance on constant fuel inflow, while fuel's transportation itself does not depend on pre-built infrastructure (as in the case of gas pipelines). At the same time, low share of fuel costs in the total nuclear plant's spendings reduces vulnerability to external price manipulations and shocks. It is only in periods of refueling

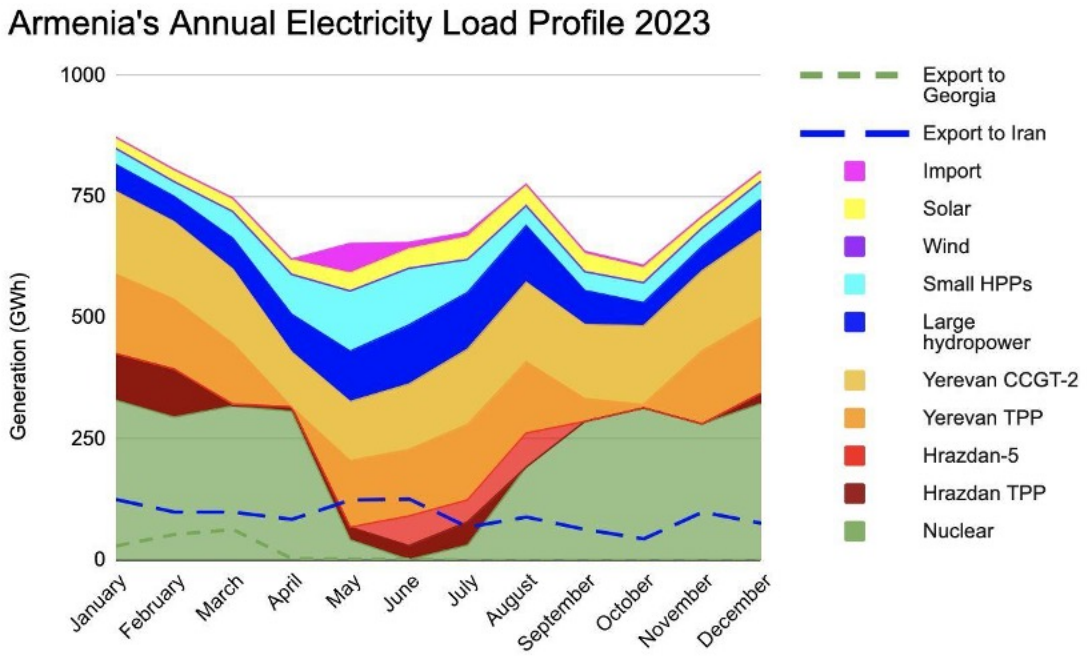

Figure 1 - Annual electricity load profile constructed by the author. Data source: psrc.am

and maintenance works that a nuclear plant is halted, resulting in an uptake of gas-powered generation (see fig 1). Overall, nuclear power is considered critical for Armenia's national energy security, particularly given the experience of the 1990s energy blockade and the limited fossil fuel supply options.

In the second group - that of recently deployed technologies - the obvious newcomer is solar energy, both in terms of power generation and thermal energy. Solar photovoltaic (PV) technologies have enjoyed a significant growth over the past few years, from virtually non-existent to supplying over 5% of domestic consumption in 2023.[3] However, relatively large shares of variable power sources in the grid can pose increasing costs on the system. Abstract modeling and international experience seem to indicate that achieving shares of solar power in the grid beyond the range of 20-25% can be extremely challenging, due to the falling benefits and rising costs in face of such problems as autocorrelation and costly energy storage.

Thermal solar panels have likewise become increasingly popular, particularly for provision of hot water. However, in the absence of district heating (which was abandoned in the 1990s) and centralized thermal storage facilities, thermal solar panels likewise face certain limitations in significantly replacing gas-powered heating. Though abundantly available, the potential of solar resource's contribution to Armenia's energy security is limited in the near future.

In the third group - the largely untapped energy sources - major options include geothermal, wind, small modular reactors, green hydrogen, bio-energy. Geothermal power potential is estimated to be at least 150 MW (World Bank, 2014), though economic viability should also be considered. While not on the same scale as thermal or nuclear power, geothermal sources in Armenia can provide a reliable output throughout the year, contributing to baseload generation.

[3] Based on data from psrc.am. This is limited to licensed suppliers of electricity to the grid; if purely autonomous consumers are included, the share of solar may be double that, if not higher.

Wind power likewise remains underdeveloped, with barely any present in the current power system. Previously estimated at around 500 MW, the updated technologies (both in terms of turbine and wind estimates) can raise these numbers by a factor of 5 (FAST, 2024). At the same time, current costs of on-shore wind are higher than for solar PV, and high system costs can likewise arise due to the variable and unpredictable nature of wind generation. For these reasons, wind power's contribution to Armenia's energy security is likewise limited, and will come into effect later in the timeline than that of solar PVs. Among electricity-focused technologies, one may lastly consider developing nuclear technologies. The current government strategy plans extend the operation of Metsamor power plant to 2036, by which point a new power plant should be constructed. Currently, various technologies are under consideration. As an alternative to standard reactor designs with 1000 MW or larger, the government is considering a number of small modular reactors with up to 300 MW capacity per unit. Such reactors can provide a number of advantages, such as longer fuel cycles and enhanced safety , as well as flexibility in refueling one reactor at a time. On the other hand, the cost per MW is projected to be higher at the early stages due to diseconomies of scale, and the technological maturity itself presents a major challenge in planning a timely project implementation.

While the emphasis on energy security often lies in electrification of transport and heating (with said electricity being generated locally), alternative applications should also be considered. Among these, major options would be various forms of bio-energy (such as biogas, biomass, etc) and, more so in the future, hydrogen. Though both may be utilized to generate electricity, their high energy density and chemical structure make them viable fossil fuel substitutes as transportation fuels, heating sources, and high temperature industrial applications. Biomass proved important for Armenia's energy security in the early 1990s, though at the cost of deforestation in an unsustainable manner. Modern technologies allow a more efficient utilization of bio-energy. Biogas derived from agricultural waste (through, for example, anaerobic digestion) can be used to supplement natural gas in the pipelines and transportation, though its potential in Armenia depends on the infrastructural setup and waste collection efficiency. On the other hand, green hydrogen is a secondary energy source,

produced through electrolysis of water utilizing renewable electricity. Its high costs of production are projected to decrease over the next couple decades, however, the degree to which it can be blended into natural gas infrastructure is limited, and significant investments would be needed to integrate larger shares of hydrogen into the system. These kinds of technologies would be critical for energy security of hard-to-electrify sectors of the Armenian economy.

Storage

Implementation of variable energy sources (such as solar and wind) poses challenges to the energy systems, in particular the electric grid, which is sensitive to fluctuations in power frequency. The primary approach to dealing with surpluses or shortages of power is to trade in real-time with neighboring countries, which requires development of interconnections. Here, Armenia plans enhancing its interconnections with Iran and Georgia (RA Government, 2020), as well as possibly with the EU through the Black Sea cable project. However, given the current geopolitical situation, Armenia's opportunities for trading electricity with its neighbors are limited. The secondary approach to managing variation in the grid is storage of excess production and its utilization during periods of scarcity. In particular, we may divide storage technologies into short-term, medium-term, and long-term storage. Efficient implementation of these technologies would facilitate integration of local variable energy sources, enabling higher energy security as a result.

Most widely utilized short-term storage technologies are flywheels, which store kinetic energy through rotation, and are able to respond quickly, albeit only for a few seconds or minutes. Such fast response mechanisms are critical for power flow management of grids with high shares of solar and wind power. Among more medium-term storage technologies, chemical batteries (such as lithium-ion and lead-acid batteries) are able to provide backup power for a period of a few hours. Finally, for longer periods, pumped hydropower storage is the most utilized solution. In particular, three sites have been identified in Armenia that could provide 150 MW of power each, for a duration of 7-9 hours. Though Armenia lacks extensive hydropower storage capacity, developing the above mentioned technologies can facilitate managing daily fluctuations in the

power system. At the same time, development of hydrogen technologies is projected to bring down the costs of storage (likely in the form of ammonia) which can act as a seasonal option (e.g. storing excess solar power in the summer and re-utilizing it in the winter).

While storing energy for the grid is important, other uses of energy can likewise benefit from having a back-up. Natural gas storage is particularly important given that the fuel is imported; the Abovyan storage facility has the capacity up to 135 million cubic meters. On the other hand, thermal storage technologies provide an opportunity to store heat for its later utilization, particularly during colder periods. Straightforward storing of insulated hot water is a widely used approach, though other technologies (such as storing heat in molten sand) are developing. Such storage technologies have the potential to provide longer, seasonal options for energy security.

Smart Grid

Smart grid entails a vast array of technologies for digitization and modernization of the electrical grid. Historically, in the absence of real-time diagnostics, monitoring, and management options for the grid, security risks were addressed through redundancy. Building extra power lines, or lines with higher transmission capacity, having back-up options and equipment - these are the traditional ways of hedging risks in case there is some damage in the grid. However, digitization of the grid enables real-time monitoring and management of the power flow, reducing the need for such double-spending. Various technologies of AI and machine learning can allow for more accurate projections of power demand and supply - enabling a better integration of distributed energy sources, such as rooftop solar panels. Advanced metering infrastructure (combined with smart appliances) enables more dynamic tariffication of the consumers, enhancing demand-sided flexibility and reducing the risk of outages. Entities called aggregators may then enable large-scale demand responses by overseeing the charging of thousands of individual appliances or electric vehicles. At the same time, digitization of energy systems makes them susceptible to cyberattacks. A resilient cybersecurity system is therefore required to protect it. Overall, smart grids, through

enhancing grid flexibility, development of decentralized energy, and reducing costs of risk management, contribute to national energy security.

Demand-side Technologies

While one approach to energy security is increasing local energy generation, an alternative (or complementary) approach would be through reducing energy demand. Energy-efficient appliances (e.g. LED light bulbs) would be some of the primary means to reducing power consumption nationwide, while energy retrofits can reduce energy required for heating and cooling. More efficient engines reduce transportation's consumption, while development of public transportation reduces the demand for private cars in general. Overall, Armenia has significant potential in energy savings. At the same time, it should be noted that such energy saving results in monetary savings, which in turn lead to higher consumption and standards of living. One should be aware of the rebound effect that energy efficiency measures can generate, the size of which can be significant (Brockway et al, 2021). While one-to-one projections between energy efficiency and consumption drops are misleading, higher energy security is nonetheless achieved through being able to provide the same essential services through less energy.

Conclusion

A survey of Armenia's energy sources indicates that there isn't a single dominant technology that can result in high energy security levels. Lack of fossil fuel reserves renders Armenia reliant on imports, lack of extensive hydropower reservoirs limits the options even further, and the relatively small economy limits the more extreme, expensive solutions such as fully nuclear-powered systems with complete electrification of transportation and heating. Therefore, higher energy security has to be achieved through a combination of various technologies and their marginal contributions, each developed to the extent that it makes sense economically, considering environmental and security costs. This is an admittedly complicated task, since balancing costs and benefits across various technologies and domains is challenging. Ancillary technologies, such as storage, smart grid, and demand-side solutions, are some of the examples that facilitate development of local energy

solutions. Market mechanisms and decentralized decision-making have to be engaged to better "guide" such a complicated process. Armenia is poised to capitalize on the global development of low-carbon technologies.

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Biosecurity and Public Health Threats

Arsen Arakelyan

Institute of Molecular Biology, National Academy of Sciences of Armenia

The Global Challenge of Rapid Infection Spread

The COVID-19 pandemic starkly demonstrated how rapidly infections can spread across the globe, driven by high levels of international migration. The initial outbreak was reported in Wuhan, China, in December 2019, and within weeks, the virus spread to numerous countries, leading the World Health Organization (WHO) to declare a global pandemic on March 11, 2020 [1]. The speed at which the virus spread was unprecedented, with infections reported in nearly every country within just three months of the first cases being identified.

Despite this rapid spread, the viral agent, SARS-CoV-2, was identified and its genome sequenced in record time by Chinese scientists and published on January 10, 2020 [2,3]. The first detection test for COVID-19 was also developed remarkably quickly after the virus was identified. The first real-time PCR (RT-PCR) diagnostic test for COVID-19 was developed within a week by a team of researchers at the Charité Hospital in Berlin, Germany, led by Professor Christian Drosten [4]. By mid-January 2020, the protocol for this test was made publicly available by the World Health Organization (WHO), allowing laboratories worldwide to begin testing for the virus.

Armenia declared the COVID-19 pandemic and introduced a state of emergency on March 16, 2020. This decision was made in response to the rapid spread of the virus and was aimed at controlling the outbreak within the country. The first batch of PCR tests from the World Health Organization (WHO) Armenia was received on March 1, 2020. PCR test production in Armenia began in June 2020 initiated by the Institute of Molecular Biology of the National Academy of Sciences of Armenia (NAS RA) [5].

The first COVID-19 samples were sequenced in Armenia in late December 2020 [6]. By that date, countries with advanced genomic surveillance systems/biotech infrastructure, such as the United States, the United Kingdom, and Germany, had submitted tens of thousands of sequences each. The UK was one of the global leaders

in SARS-CoV-2 sequencing. Their well-established research and healthcare systems allowed them to quickly scale up sequencing efforts, contributing large amounts of data to the global effort to track and understand the virus. Countries comparable with Armenia population-wise, such as Estonia, Lithuania, and Singapore contributed thousands of sequences providing detailed insights into the virus's transmission [7].

During the COVID-19 pandemic, another critical vulnerability was exposed: the fragility of global logistics channels. The pandemic led to unprecedented disruptions in global supply chains, revealing how heavily interconnected and interdependent the world had become. As borders closed, transportation networks halted, and manufacturing hubs slowed down or shut down entirely, many countries found themselves isolated, unable to access essential diagnostics, drugs, vaccines, and other critical medical supplies. As countries prioritized their own populations, export restrictions were imposed on medical supplies and raw materials needed to produce vaccines and treatments [8].

For Armenia, with limited access to international markets and a landlocked geography, the disruption of global supply chains during the pandemic had particularly severe implications. Armenia's dependency on imported medical supplies, diagnostics, and pharmaceuticals meant that any delay or disruption in the global supply chain could have dire consequences for public health. The country's limited manufacturing capacity made it difficult to produce essential medical supplies domestically, leaving the population vulnerable to emerging health threats.

During the COVID-19 pandemic, the global biotech industry underwent a significant shift, with research and development (R&D) efforts largely pivoting towards therapeutics, vaccines, and protective measures against SARS-CoV-2. In countries with well-established biotech infrastructures, the response to the pandemic was swift and multifaceted. For instance, in the United States, companies like Moderna and Pfizer, supported by years of prior investment in mRNA technology, were able to develop COVID-19 vaccines in record time. This achievement was underpinned by robust R&D capabilities, extensive preclinical infrastructure, and strong public-private partnerships. Similarly, in Germany, BioNTech rapidly adapted its cancer vaccine platform to develop one of the first COVID-19 vaccines, showcasing the flexibility and readiness of advanced biotech infrastructures. The United Kingdom also demonstrated

its robust infrastructure by quickly mobilizing resources to develop and produce vaccines, diagnostic tools, and therapeutics. The UK's ability to conduct large-scale clinical trials and its strategic stockpiling of necessary materials were critical to its effective pandemic response [9].

However, the situation in Armenia was markedly different. The country lacked the major infrastructure required to quickly shift towards COVID-19-related R&D, nor did it possess the capacity to produce and test therapeutics, tests, or vaccines at scale. This limitation left the country heavily dependent on international supply chains for diagnostics, treatments, and vaccines, which were often delayed due to global competition and logistical challenges.

Lessons learned from the COVID-19 pandemic

The COVID-19 pandemic has provided several critical lessons for Armenia that can guide the country's future preparedness and response to public health emergencies and biological threats. Some of the key lessons are:

1. **Invest in Local Biotech Infrastructure**
    a. ***Lesson:*** The pandemic exposed Armenia's dependency on external sources for diagnostics, vaccines, and therapeutics. This reliance led to delays and limited access to essential medical supplies. Building local capabilities in biotech research, development, and manufacturing is crucial for timely and self-reliant responses to future health crises.
    b. ***Action:*** Armenia should prioritize the development of research facilities, preclinical testing infrastructure, and manufacturing plants capable of producing diagnostics, vaccines, and treatments locally.

2. **Enhance Genomic Surveillance and Early Detection**
    a. ***Lesson:*** Rapid identification and tracking of SARS-CoV-2 variants played a critical role in managing the pandemic. Armenia's limited capacity for genomic surveillance hindered its ability to monitor the virus's evolution within the country.

b. ***Action:*** Strengthening genomic surveillance systems and integrating them into the national healthcare framework will allow for faster detection of emerging pathogens and better management of outbreaks.

3. Build a Strategic Stockpile of Medical Supplies

a. **L*esson:*** The disruption of global supply chains during the pandemic highlighted the risks of relying solely on international markets for essential goods. Many countries faced shortages of PPE, ventilators, and other critical supplies.

b. ***Action:*** Armenia should develop a strategic stockpile of medical supplies, including PPE, ventilators, and other essential equipment, to ensure that it can maintain healthcare operations during crises.

4. Promote Vaccine and Public Health Literacy

a. ***Lesson:*** Public understanding of vaccines and adherence to public health measures were crucial in controlling the pandemic. Misinformation and vaccine hesitancy posed significant challenges.

b. ***Action:*** Armenia should invest in public health education campaigns to improve vaccine literacy and combat misinformation, ensuring higher compliance with health guidelines during future outbreaks.

5. Develop Emergency Response Plans

a. ***Lesson:*** Countries with pre-existing, well-developed emergency response plans were able to respond more effectively to the pandemic. Armenia's response, while proactive, was hampered by the lack of a comprehensive, integrated pandemic preparedness plan.

b. ***Action:*** Developing and regularly updating a national pandemic preparedness plan that includes clear protocols for coordination among government agencies, healthcare providers, and international partners is critical.

6. Invest in Educational Programs for Specialized Biotech, Biomedical, and Public Health Expertise

a. ***Lesson:*** The COVID-19 pandemic highlighted the critical need for a diverse range of experts who are equipped to handle various aspects of pandemic response, from epidemiology and virology to health policy and logistics. Armenia faced challenges due to a shortage of specialists with the necessary expertise to manage the complexities of the pandemic.

b. ***Action:*** Armenia should invest in developing and expanding educational programs that train specialists in fields essential for mitigating public health risks and biological threats. This includes disciplines such as molecular biology, genomics, infectious disease research, public health policy, epidemiology, biotechnology, bioinformatics, and healthcare management, including digitization of the healthcare system. By building a workforce of well-trained professionals, Armenia can enhance its capacity to respond effectively to future public health emergencies.

Another significant limiting factor in Armenia is the underdevelopment and consequently minimal investment in R&D within the private biotech and pharmaceutical sectors. This lack of robust private industry involvement severely constrains the potential for effective public-private partnerships, which are essential for driving innovation and accelerating research. To address this the Government of the Republic of Armenia passed Decree No. 811-L of May 25, 2023, "The Five-Year Development Program for the Pharmaceutical Industry and the Program of Measures Ensuring its Implementation." It addresses several defined objectives, including "actions aimed at investments in new drug research". Additionally, another challenge is the complicated legislative framework, particularly the Law on Procurement. This law significantly slows down the acquisition of reagents, equipment, and materials in public institutions, and limits the opportunities for cooperation between the public and private sectors. Streamlining these legislative processes is crucial to enhancing the efficiency of research and fostering stronger public-private collaborations.

By learning from these lessons and taking proactive steps to address the gaps revealed by the COVID-19 pandemic, Armenia can build a more resilient health system

capable of effectively managing future public health emergencies and biological threats.

The Persistent Threat of Pandemics

The threat of viral pandemics has not diminished; instead, it has become more frequent and varied, posing continuous challenges to global public health. The COVID-19 pandemic served as a stark reminder of how rapidly a novel virus can spread and disrupt societies worldwide, but it is far from the only viral threat humanity faces. In recent years, we have witnessed the resurgence of several other viral pathogens, each capable of causing significant public health crises.

Recent examples include the resurgence of monkeypox, measles, and the West Nile virus. These viruses, while different in their transmission and pathology, have all demonstrated the capacity to cause severe illness, strain healthcare systems, and disrupt daily life.

The recent reports of monkeypox cases in neighboring Turkey further emphasize the regional risk [10]. Though the ground border between Turkey and Armenia is closed there are flights between the two countries. Moreover, ground transportation from Turkey to Armenia is possible through Georgia. Given the close proximity and movement of people across borders, there is a heightened risk that the virus could spread to Armenia. The monkeypox outbreak in Turkey also serves as a reminder of how quickly a virus can cross borders and affect countries that may not be traditionally considered at risk for such diseases.

Armenia has recorded 554 cases and 547 cases of measles, in 2023 and 2024, respectively [11]. The situation remains concerning, and continuous monitoring of the outbreak is essential.

The West Nile virus, primarily transmitted through mosquito bites, has also shown a troubling trend. Originally confined to parts of Africa, Europe, and the Middle East, it has now been detected in various regions, including Armenia. As of 21 August 2024, 58 cases of West Nile fever have been detected in Armenia [12]. Among these cases, 41 patients have been hospitalized, with four in serious condition and one death. The

affected provinces are Aragatsotn, Armavir, and Ararat. While they expect infected mosquitoes to be present in these regions, the virus has been confirmed only in the Aragatsotn region so far.

The persistent threat of viral pandemics, evidenced by the resurgence of diseases like monkeypox, measles, and West Nile virus, is a clear reminder that Armenia must remain vigilant and prepared. The country's ability to protect its population from these threats will depend on its investment in public health infrastructure, research capabilities, and international cooperation. By taking proactive measures now, Armenia can strengthen its defenses against the inevitable future challenges posed by various pandemics.

Steps towards strengthening Armenia's biosecurity

Several key steps need to be taken to establish an effective pathogen surveillance, research, and containment infrastructure in Armenia. Achieving this will require significant investment, and not all measures can be implemented simultaneously. However, Armenia's research institutes and universities can play a foundational role in creating such systems. Moreover, significant investments in research infrastructure by the Higher Education and Science Committee are already addressing some critical gaps. For instance, in 2023, the Institute of Molecular Biology established a next-generation sequencing core facility. This facility can serve as a central resource for sequencing and characterizing various pathogens, providing a crucial foundation for Armenia's efforts in pathogen surveillance and biosecurity. To build a resilient biosecurity framework, a few strategic steps can be taken to strengthen Armenia's R&D capacity:

- **Establishment of biosafety level 3 national lab and an adapted viral strain library**

  In a BSL-3 laboratory, it is possible to conduct a variety of virological studies. Specifically, viruses can be isolated from patients and adapted to proliferate in cell lines, which would allow the creation of a proprietary collection of viral strains. These strains could then be used to evaluate the effectiveness of antiviral drugs, repurpose existing medications, and discover new therapies. The availability of a local collection of viral strains allows for: 1) large-scale testing of chemical

compounds, and 2) computer screening for identification of the most active chemical compounds against viral targets that can be subsequently tested against the virus in preclinical and clinical settings

- **Infrastructure for developing diagnostic test systems**

  Most diagnostic kits rely on antibody- or PCR-based reactions to detect pathogens in both point-of-care and laboratory settings. Armenia needs to rebuild its capacity to produce essential components such as enzymes, antibodies, and oligonucleotides, which are crucial for the development of these diagnostic tests. Restoring this capacity not only strengthens the country's biosecurity but also opens new business opportunities within the biotechnology sector.

- **Preclinical research infrastructure**

  One of the critical initial steps in combating a pandemic is the rapid identification of effective therapeutics. Preclinical testing of new drugs on animal models is a critical step in evaluating their efficacy and safety before advancing to clinical trials. In the field of antiviral research, small rodents such as mice and rats are predominantly used for these studies, though other animals, such as guinea pigs, rabbits, and pigs, may also be employed in certain cases. Research using animal models encompasses a variety of essential evaluations, including the measurement of antiviral titers post-treatment, assessment of morbidity and mortality rates following infection, monitoring changes due to treatment, and studying potential side effects. Additionally, these studies involve analyzing the pharmacodynamics and pharmacokinetics of the drugs, conducting histological examinations, monitoring antibody production, and evaluating the toxicity and safety of the compounds.

  Implementing the proposed strategic initiatives will bring multiple benefits to Armenia. Establishing a Biosafety Level 3 (BSL-3) laboratory, developing diagnostic test systems, and enhancing preclinical research infrastructure will significantly strengthen the country's pathogen surveillance, research, and containment capabilities. These efforts will also reduce Armenia's dependency on external resources, enabling quicker and more effective responses to public health threats.

Moreover, investing in these infrastructures will stimulate the growth of Armenia's science and biotech R&D sectors, creating new business opportunities and fostering innovation. These developments will not only enhance public health security but also contribute to the economic and academic landscape by providing platforms for high-level research and development. Additionally, these initiatives will greatly benefit educational programs by offering training opportunities for skilled researchers and specialists, helping to build a well-equipped workforce capable of addressing future challenges in public health and biotechnology.

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Networking for Security Assistance – The Role of the Diaspora and the Importance of Defense Diversification in Armenia's Security

Scott Fisher

As we know, Armenia has begun diversifying its defense suppliers and partners, as part of the shifting geopolitics of its near abroad. Interestingly, this process began even before Azerbaijan invaded Artsakh in 2023, as Russia, despite having peacekeepers on the ground charged with preventing such an attack, failed to intervene (Dixon and Ebel, 2023). Whether due to lack of interest, shifting priorities, lack of capability, or a combination of factors, Moscow effectively abandoned its role as Armenia's security guarantor during the conflict, then withdrew its peacekeepers several months later (Bagirova, 2024).

With Russia unreliable at present, Armenia sees no choice but to expand efforts seeking security assistance elsewhere. While it has enjoyed some success in these efforts, as detailed in EVN Report's recent study of the country's defense diversification (Nazaretyan, 2024), it is unlikely to find a new security guarantor of Russia's heft. There is little chance the US will become Yerevan's guarantor (Haberman and Cormarie, 2024), nor is there another regional or outside power likely to fill this role in the immediate future. This leaves Yerevan with a need to pursue defense diversification for the foreseeable future.

As detailed in the Nazaretyan report, efforts to date have included work with a wide range of countries and supranational organizations: India, France, Greece, Czechia and Slovakia, Italy, Bulgaria, Germany, the US, EU, and NATO. While Russia continues to maintain some troops in Armenia, recent Russian assistance and interest have been limited. Notable by their absence from the large and growing list of security assistance providers: China, Israel, and Great Britain.

While impressive diplomatic skills will be required to obtain security assistance from China without harming existing relationships with the US and others, Armenia is hardly the only country needing to walk this line. Countries from Djibouti to Brazil have successfully engaged in such balancing for years, offering models for Yerevan to emulate (Berg and Baena, 2023; CRS, 2021). Other important providers are likely to

provoke less controversy, though Israel's history of support for Azerbaijan may make that relationship a greater challenge for Armenia (Debre, 2023), albeit with a greater potential payoff if Yerevan can effectively attenuate the Baku-Tel-Aviv relationship.

Path Forward

Security assistance can help with a variety of needs, both short and long-term, including hard or soft power, training, equipment, etc. Success in these efforts requires patience, endless rounds of meetings, coordination across countries and proposals, and a clear, ongoing needs assessment. It is difficult to overstate the importance of this final item. Without a needs assessment carefully aligned and updated across time, space, and specific requirements, successful integration of security assistance can become impossible, leaving warehouses of new equipment slowly rotting, alongside growing donor frustration. Important subcomponents here are not only acquiring *items*, but also the related *training* (and creating realistic exercises to build on that training), plus the full complement of relevant equipment (e.g., requisite technical systems to mount on drones/aircraft, adequate and ongoing ordinance supplies for newly obtained weapons, etc.).

Armenia's government, mainly the foreign and defense ministries, are clearly engaged in these activities already, as noted in the Nazaretyan report. But this is a demanding, competitive, ongoing task that requires adequate resources, from defense funding to personnel with the appropriate language and technical skills. By supporting officials engaged in these tasks, including work as basic as arranging introductions and meetings, the diaspora may be able to assist Yerevan in further expanding or improving this vital work.

Traditional security assistance is mainly government-to-government, typically military-to-military. But as the Ukrainians have so ably demonstrated since February 2022, the domestic and international tech sectors have increasingly important roles to play in modern warfare, from drones to cybersecurity to satellite communications (e.g., *Starlink*). While it can be difficult for the diaspora and other outsiders to get deeply involved in traditional security assistance, aside from harnessing their political weight to push their respective governments to support Armenia, tech-related assistance is an

arena where non-government entities can play a significant role. So far, any effects generated for Yerevan by such support have been limited, but the potential is clear.

Role of the Diaspora

There appear to be two key roles the diaspora can play in increasing the amount and diversification of security assistance to Armenia: 1) a coordination role, and 2) a tech-related role. By working with their respective governments to increase support for Armenia in general, and for specific defense items in particular, the diaspora can contribute to Yerevan's ongoing efforts to increase inbound security assistance. From introductions to specific officials and business leaders, to political letters of support or targeted investments in key sectors, overseas Armenians can help Yerevan plan and coordinate security assistance activities. The more effectively these support efforts are coordinated across governments, militaries, businesses, and civilian groups, the greater their eventual impact; the more they appear random, isolated, and disconnected from clearly-defined needs, the less effective they will become. It is vital that any group(s) selected to manage this coordination role have the experience, connections, and funding to succeed.

Second, as discussed above and as seen regularly in Ukraine since 2022, the tech sector has a vital role to play in modern warfare. To the extent the diaspora can support Armenia with relevant technologies and capabilities, it can play an outsized role in helping Armenia improve its defenses. While many areas are likely of interest to Yerevan, key areas include cybersecurity, drones and counter-drone technology, information warfare, communications (including command and control related), and battlefield sensors. As mentioned above however, needs assessments are an important, ongoing activity—as needs change, so must assistance-related activities.

An important aspect of this support is that much (but emphatically, not all) of it can be done remotely. Again, lessons learned from Ukraine since 2022 highlight the role outsiders can play in everything from arranging meetings to foster support, to active, ongoing assistance with cybersecurity, intelligence, and data analytics (Smith, 2022). Sending blankets, diapers, funding, and other items to those in need is, of course, laudatory; but those desiring to provide technical or capacity-building assistance may

find attractive opportunities to play a role in supporting Armenia. Again, coordination across government and non-government entities is important, as are ongoing needs assessments to ensure contributions are effectively aligned to and then integrated with actual needs. In any event, the opportunities are real and unlikely to disappear.

Conclusion

As Armenia navigates a complex and rapidly evolving security landscape, diversifying its defense partnerships and suppliers has become an imperative. With Russia no longer a reliable security partner, Yerevan must continue to expand its efforts to seek security assistance from a range of countries and organizations. The diaspora has a critical role to play in supporting these efforts, whether through coordination and advocacy with their respective governments or by providing tech-related assistance in areas such as cybersecurity, drones, and information warfare. By working together, the diaspora and Armenia's government, including the foreign and defense ministries, can help ensure the country's security and sovereignty in a challenging and unpredictable region.

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Information as a Tool for Deterring or Punishing Baku - How Armenia Can Target Azeri Weaknesses to Help Counter Baku's Military Power

Scott Fisher

Abstract

This paper proposes a novel approach for Armenia to counter Azerbaijan's military advantage by exploiting the latter's authoritarian weaknesses. Specifically, it highlights the potential for Armenia to gain a long-term, asymmetric advantage by targeting Azerbaijan's reliance on information control to maintain its regime. By leveraging open-source data collection and analysis, Armenia can identify and challenge Azerbaijan's censorship practices, undermining its ability to control the narrative and maintain power. The paper draws on existing research on authoritarian states' vulnerabilities to information activities, demonstrating that even simple "naming and shaming" campaigns can elicit powerful negative responses from authoritarian regimes. It outlines two potential options for Armenia to further target Azerbaijan's weaknesses: a messaging campaign and a counter-censorship campaign. While these options carry risks, they offer a relatively quick and cost-effective means for Armenia to deter, compete with, or punish Azerbaijan. The paper concludes by highlighting how information tools can provide Armenia with a valuable capability to help restore balance to the Armenian-Azerbaijan relationship, particularly during a time of Armenian military weakness. By targeting Azerbaijan's authoritarian weaknesses, Armenia can gain a strategic advantage and create a more stable regional environment. Ultimately, this approach can buy time for Armenia to improve its military capabilities and reduce the imbalance that has proven so destabilizing.

Introduction

To overcome losses in the 1990s, Azerbaijan took (or was forced to take) a multi-decade approach to the conflict with Armenia. Despite the amount of time and investment required, the result was eventually a success for Baku, as it retook Artsakh. This has put Yerevan in the difficult position of having to deter and defend against additional Azeri attacks in the short term, while also building capacity over the long-term to similarly improve the power imbalance.

Unable to match Baku dollar-for-dollar in terms of oil-funded military spending, Armenia needs an approach that plays to Yerevan's strengths. While Baku can pay to import equipment and capabilities, it has proven less able or willing to develop its human capital. This is an area where Armenia, including the diaspora, appears to have a competitive advantage – training and unleashing a higher-tech workforce. Second, Azerbaijan, as an authoritarian state, relies heavily on domestic information control—censorship—to maintain power for the ruling family and party. This reliance on information control, compared to the relatively open and free Armenian information environment, is an underutilized advantage for Yerevan.

By combining these two elements Armenia can gain security-relevant advantages in areas difficult for Azerbaijan to counter. This does NOT obviate the need for Yerevan to add hard power capabilities. Armenia will always need soldiers, aircraft, tanks, drones, missiles, and the related training, equipment, and capabilities of military force. This proposal is in addition to, not in lieu of, those efforts. The focus is assisting Armenia in targeting specific structural weaknesses in Azerbaijan, helping Yerevan gain a long-term, asymmetric advantage valuable during competition, deterrence, and conflict.

The Information Threat to Authoritarian States

For Baku, like its authoritarian peers in Russia, China, North Korea, and elsewhere, information control is vital for regime preservation. Control of information, not just a dominant narrative but controlling the actual networks over which data and information flow, allows authoritarians to successfully rationalize poor economic performance, identify and mitigate potential or actual opposition, decrease protests, and increase the overall durability of the regime (Kendall-Taylor et al, 2020; Fisher, 2018; Guriev and Treisman, 2015).

This information control, termed by one researcher the *garrison cyber system*, maintains that high levels of sovereign control over information helps prevent citizens from accessing politically undesirable content (Choucri, 2000). States exert this control to help prevent "pernicious information" from reaching the general populace and creating unwanted pressure for change (Kello, 2017). This practice is designed to help insulate

authoritarian states from outside influences, in contrast to their more open, democratic peers.

Because of this reliance on information control, authoritarian states react quite negatively when that control is challenged. China, for example, reacts more negatively to criticisms of its information controls than it reacts to economic sanctions or even joint US-Taiwan military exercises (Fisher et al, 2024). Russia is similar, responding more negatively to international demands seeking less censorship and greater information access than it does to economic sanctions or NATO military exercises (Fisher, 2019).

Azerbaijan is similarly reliant on information control to maintain its regime, and thus vulnerable to activities challenging that control. Whether through outside political and diplomatic pressure to relax the controls or technical means to reduce their effectiveness, any degradation of such controls fosters two outcomes that authoritarians fear: greater amounts of outside information flowing *into* a country and greater uncensored information flows *within* a country, undermining the controls authoritarians rely on to maintain power and creating a powerful asymmetric tool with which to deter or punish an authoritarian adversary.

Open-Source Data Collection and Analysis

It is important to note that the powerfully negative responses by authoritarian states discussed above were achieved by simply drawing attention to the states' censorship practices. They did not involve actions other than criticizing or 'naming and shaming', yet still created responses more negative than economic sanctions or military exercises. Armenia can quickly harness these findings to deter, compete with, or punish Azerbaijan in a meaningful, cost-effective manner. To go further is possible, as discussed next, but requires additional capabilities and an appetite for greater risk.

Beyond drawing attention to Azeri information controls, as measured by international human rights groups like *Reporters without Borders*, *Freedom House*, or similar groups (the organizations that helped cause the negative effects cited above), Armenia could employ two additional options to further target Azeri weaknesses: a messaging campaign and a counter-censorship campaign. Both entail risks and require assets and capabilities beyond simply drawing attention to Azeri censorship. We will first examine a

possible messaging campaign, before turning to the more technical counter-censorship campaign.

The first option requires advanced capabilities for open-source data collection and analysis. Who are the key Azeri individuals, groups, and narratives that might be open to outside information flows? What are the most common media outlets in Azerbaijan? Not just the main TV and radio stations, but the most common Telegram, Facebook, X/Twitter, VK, YouTube, TikTok, etc. pages, channels, and accounts? What accounts belong to which leaders? Not just the President and other executive-level leaders, but every account belonging to every colonel (or equivalent) and above, every senior official and above, every ruling party senior official, every key reporter, opposition leader, religious figure, community group leader, business leader (especially any who have recently lost a competition for a state contract), and others?

From these accounts, what are the key narratives? Even authoritarian states have groups belonging to different factions; what are the key groups/factions? What issues divide them? How do these factions speak and argue with one another – what are the key terms, narratives, players, etc.? What memes, images, videos, hashtags, etc. are most common or influential?

Who—what organizations—in Armenia (or supporting Armenia) can effectively collect and analyze this open-source data, then create relevant, interesting, related messaging? What platforms and software will they employ? Who can be trusted and effective in engaging with Azeri accounts, individuals, and organizations? Can any organization build popular Azeri language accounts? Who can coordinate such a campaign?

Once all of this information is in place, with related personnel, software, and organizational structure(s), Armenia could begin an information campaign targeting specific people with specific messages designed to advance its interests and undermine those of Baku. Key prerequisites for such campaigns include the ability to effectively collect and analyze the large amounts of data required for such work and a means for introducing the messages into the Azeri information environment.

Effectively conducting a campaign like that outlined here is difficult, which is why successes are rare. Targeting a country with such a campaign also carries risks of provoking the targeted country, who may respond militarily. As we saw above, such a campaign may even be unnecessary, since naming and shaming activities by international NGOs, the UN, and other organizations has proven so effective. Is the additional risk of this more advanced information campaign worth the additional costs and (possible) repercussions?

The second option for targeting Azeri weaknesses is to challenge the actual controls that prevent information from entering the country. In the pre-internet era, this involved capabilities like Voice of America and Radio Moscow, copy machines and underground presses, embassy/consulate lending libraries, and a wide variety of similar non-digital activities to get information into specific spaces. Though largely overtaken by other capabilities in the internet era, such activities do continue to occur, including, for example, the ongoing use of balloons carrying banned content from South Korea that regularly angers North Korea (Fisher, 2018).

In the internet era, cyber capabilities—especially those that allow an actor to eliminate or overcome access controls—have become a key means for getting information into or out of controlled spaces. Any nascent capabilities that could allow Yerevan to selectively remove or render inoperable, either long-term or at a time and on a specific system of Yerevan's choosing (i.e., in coordination with a targeted information campaign of the type discussed above), would help Armenia further exploit this Azeri weakness. By demonstrating the ability to overcome Azeri censorship and information controls, this option, while likely perceived as escalatory, would provide Yerevan with a powerful new capability for deterring or punishing Azeri actions. Successfully enabling this option requires the type of higher-level, cyber-focused human capital development mentioned at the paper's outset; the diaspora and other outside partners may be able to assist with this development.

Conclusion

Authoritarian states' reliance on information control to maintain support creates an opportunity for states attempting to deter, compete with, or punish authoritarian regimes.

While authoritarian targeting of the open information environments of democratic states is well known, from efforts to influence US elections, to Britain's Brexit vote, to Taiwanese and French elections, authoritarian weaknesses to information activities are much less well known. This paper rectifies that imbalance by highlighting authoritarian vulnerabilities to information tools, and showing how Yerevan could strategically harness such vulnerabilities to help overcome some of its current weaknesses vis-à-vis Azerbaijan.

By harnessing the findings here, from naming and shaming to the more advanced (and likely more provocative) options of coordinated information campaigns or counter-censorship activities, Armenia gains a utile tool for deterring or responding to Baku. As mentioned at the outset, information tools do not obviate the need for military capabilities; their importance is in providing an additional capability to help restore balance to the Armenian-Azerbaijan relationship during a time of Armenian military weakness, doing so quickly and cost-effectively by targeting a known authoritarian weakness. Used properly, this tool can help return stability to the region while buying time for Yerevan to improve the imbalance in military capabilities that has proven so costly, dangerous, and destabilizing.

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Countering Disinformation Campaigns Against Armenia

Hriar Cabayan

Background

Sophisticated information/disinformation campaigns are part and parcel of the global geopolitical environment. These are employed to support geopolitical interests and can foment discord and create fissures within societies. Armenia needs to develop an effective counter messaging capability. To be effective, these responses need to be rapidly and effectively formulated and disseminated.

Outline

The following topics are addressed in the article:

- Overall Strategy to Counter Disinformation
- Technical Approach
- Required Expertise and Technical Capabilities
- Approaches to Enhance Population Resilience

Overall Strategy to Counter Disinformation

For Armenia to effectively counter disinformation campaigns, several RAPID interconnected capabilities are needed.

- Identify the origin of the hostile disinformation campaigns
- Analyze the content
- Identify intended audience
- Assess societal resilience and active/total defense capability
- Formulate an effective counter messaging campaign
- Disseminate the counter messaging in the appropriate public media
- Assess proactive narrative generation (i.e., not solely a response to the specific piece of disinformation but new messaging in the same topic area)

There are several capabilities that need to be developed and integrated into an end-to-end capability on the technology and thematic fronts

- AI algorithms and Machine learning tools can sift through large datasets to identify data of interest.
- These are combined and analyzed by appropriate subject matter experts for more accurate assessment. This approach increases the efficiency and speed of data analysis and improves the reliability and precision of the counter disinformation campaign.

Technical Approach

Before embarking on an overall technical approach, there are key technical questions that need to be addressed by appropriate experts:

- What is the specific, desired goal or outcome of the Artificial Intelligence/Machine Learning (AI/ML) assessment?
- How much and what kind of training data specifically would be needed to reach a reasonable standard of disinformation identification or characterization using the AI/ML tools?
- There may be different types of disinformation that need to be considered
    - Lies about facts that could in theory be “ground-truthed” (“low-hanging fruit”)
    - Lies in terms of the framing of events (e.g., “they did this because of this reason” – when this framing is not based in reality)

For an effective approach, several steps need to be considered:

- Assemble a core technical team that identifies, compiles, and analyzes the disinformation material

- Identify source(s) of disinformation campaigns and prioritize which of these to counter
- Analyze campaign content, identifying primary objects or targets of campaigns
- Identify experts to design content and dissemination methods for appropriate counter-disinformation and pro-active messaging responses
- Identify intended audience
- Formulate effective counter messaging campaign
- Generate pro-active narratives on the same topic(s): Go beyond reacting to or countering disinformation to actively devise what messaging about the topic you want to communicate
- Disseminate responses using appropriate public media (the response "vectors")

Required Expertise and Technical Capabilities

This will require a core group that gathers and analyzes the disinformation, assigns one or more experts from a database to write a response depending on the topic of the disinformation, and then disseminates the article to the appropriate media. The core group requires expertise in AI/ML, ability to understand the nature of the disinformation and select the right expertise from the database, and proper connections to the media. This campaign need not be limited to responding to disinformation. It can also generate and disseminate articles on topics of importance to Armenia.

Several capabilities need to be developed and integrated into an end-to-end approach on the thematic and technology fronts. These include:

- Expertise in using search tools (i.e., Bing, Firefox, or other appropriate) to initially identify data sources and content of interest
- "Data scraping" tool that can generate corpus for analysis from identified sources

- AI algorithms and Machine Learning (AI/ML) tools that can sift through large datasets to perform an initial assessment (identify disinformation drawn from the public domain) and cross-validate on a separate sample of data
- Appropriate experts to formulate counter-disinformation and pro-active campaign material
- Experts to disseminate responses in appropriate media (social and/or traditional)
- Public opinion/survey experts to measure population's relevant attitudes
- "Humans in the loop": Experts that can properly design and appropriately use AI/ML tools and examine the results using these tools for any needed adjustment for accuracy, etc.
- Trainers, teachers, or appropriate others to assist the population in increasing its resilience

This technology-aided approach increases the efficiency and speed of data analysis and improves the precision and likely effectiveness of campaigns to counter disinformation.

Approaches to Enhance Population Resilience

As part of developing counter disinformation campaigns, population resilience and critical thinking campaign need to be assessed. These include:

- Societal resilience and active/total defense capability
- Providing people the tools to recognize and think critically about information they receive
- Explore using accuracy nudges that prompt consideration of information veracity before sharing or active bystander training that teaches people to recognize and intervene to correct false information and slow its dissemination and proliferation

There are also long-term approaches that that need to be considered via elementary education. These include enhancing information and communications technology (ICT)

to increase access to accurate and potentially useful information and decrease perception of “useless media.”

There are also other options that need to be addressed including the following:

- Assess vector by which resilience can be enhanced
- Accuracy nudges: Prompt consideration of information veracity before sharing
- Active bystander training: Where people are taught to recognize and intervene to correct false information
    - Helps to combat dissemination of false information
- Slow proliferation of multiple, competing narratives
- Enhance information and communications technology (ICT)
- Increase access to accurate and potentially useful information

Bottom Line: Countering Disinformation Campaign will require a long term multi-disciplinary strategy with adequate capability to assess the effectiveness of the various tools and approaches.

Historical Falsifications Carried out by Azerbaijan: A Case Study

Robert Ghazaryan and Haykuhi Muradyan

For decades, Azerbaijan has systematically engaged in the falsification of historical narratives, distorting and appropriating the cultural and historical heritage of neighboring countries, particularly Armenia. This deliberate campaign, which intensified during the post-Soviet era, seeks to erase Armenian presence and influence in the region. By fabricating historical accounts and promoting false narratives, such as the misrepresentation of the Azerbaijani identity and territorial claims over Armenia, Azerbaijan aims to legitimize its aggressive actions and undermine Armenian cultural heritage, especially in contested regions like Artsakh. Since the establishment of the Republic of Azerbaijan, the appropriation of Armenian cultural heritage and history has been an integral component of Azerbaijan's state policy. This includes both physical destruction and manipulative practices such as renaming and distorting historical realities. The overarching objective of this policy is to legitimize territorial claims and establish a narrative suggesting that Azerbaijan or their historical "ancestors" have longstanding roots in the region. Despite obstacles posed by the enduring presence of Armenians in the area and a rich cultural heritage, Azerbaijani policy has consistently aimed at advancing this narrative. This goal persists, with Azerbaijan employing various methods to exploit cultural heritage, both during times of peace and conflict.

From September 19th to October 5th, 2023, Azerbaijan completed a plan of ethnic cleansing of Armenians from The Republic of Artsakh, an area where Armenians have lived for centuries. This happened gradually over three years, involving a big war in 2020, continuous breaking of ceasefire agreements, and slow military advances after the fighting officially stopped. From December 2022, there was a ten-month blockade, cutting off important resources like gas, electricity, and aid. In the final stage, there was a one-day war and Azerbaijani forces took control up to the outskirts of Stepanakert, the capital of the Republic of Artsakh. Faced with a serious threat, more than 100,000 Armenians living in Artsakh, almost the entire population forcibly moved to Armenia in just one week.

The aftermath of this military action has stirred heightened apprehension over the potential threat posed to the rich Armenian cultural heritage that remains in the region.

Approximately 6,000 monuments in Artsakh, more than 3 dozen museums and private collections are now within the control of Azerbaijan which is very well known for its unwavering intolerance towards Armenian historical and cultural evidences.

The “Geghard” Scientific Analytical Foundation (see Appendix) reacts to the historical falsifications carried out by Azerbaijan in numerous publications, media announcements and in the different socio-cultural events both within Azerbaijan and out of the country.

For example, in 2024, an interview with Hasan Hasanov was published in Azerbaijani media, in which he presents a distorted account of various episodes of history. Hasanov asserts that "the Azerbaijani people were referred to as Atropatene-Azerbaijani in Greco-Roman sources 2,300 years before Stalin." (see ''The Azerbaijani scientist pushed back the famous historical event by 300 years''). In addition to being pseudo-scientific and replete with misrepresentations and fabrications, the statements made in the interview also exhibit a fundamental lack of logical coherence. It is evident that the state established by Atropates in the fourth century BC has no direct correlation with the modern state of Azerbaijan. Moreover, Hasanov posits that Atropatene was established three centuries prior, coinciding with the dissolution of the Assyrian Empire in 612 BCE. To substantiate his assertion, the author cites Roman and Assyrian sources from a subsequent era, which offer no indication that Atropatene originated in the seventh century BCE or bears any resemblance to the contemporary Azerbaijani state. For further information on this topic, please refer to the following materials from the Geghard Foundation.

Historiographical falsifications regarding the history of Azerbaijan

There is no toponym Azerbaijan in any mediaeval map, Ruben Galichian

In response to the question of why the modern Azerbaijanis were referred to as Tatars during the Tsarist and early Soviet periods, Hasanov offers a compelling explanation. He asserts that the name "Azerbaijani" was effectively banned, which would explain why the Tatars were referred to by this term. For further insight into the creation of the image of a medieval Azerbaijani in the Soviet era, one might consult the following articles.

The comparison of the creation of "Medieval Azerbaijani" during the Great Patriotic War according to I. Petrushevsky's works

The population of Baku in the 19th century

The historical record demonstrates that the designation "Azerbaijani" was applied to Azerbaijanis residing in the territory of modern Azerbaijan in accordance with the policies implemented by the USSR in the 1920s and 1930s. In 1937, the term "Azerbaijani people" was included in the Constitution of Soviet Azerbaijan. Furthermore, in 1939, the All-Union Census designated representatives of the titular people of Azerbaijan (as well as the Turkic-speaking Muslims of Soviet Armenia and Soviet Georgia) as "Azerbaijani." Although Hasanov asserts that Stalin was not involved in the establishment of the ethnonym "Azerbaijani," it was during Stalin's tenure that this designation became prevalent among the contemporary Azerbaijanis.It is widely acknowledged that the Aliyev regime invests significant resources in the fabrication of Azerbaijan's historical narrative and the appropriation of the historical and cultural heritage of neighboring countries and peoples. The Azerbaijani specialists responsible for this undertaking commenced their activities during the Soviet era, but they became more active in the post-Soviet years. The Azerbaijani authorities have primarily targeted the Armenian people and Armenia. All possible means are employed to distort and appropriate the history of the Armenians and Armenia. Furthermore, Armenians are accused of committing acts that they themselves did not perpetrate. A case in point is the so-called "Khojaly" events. The Azerbaijani armed forces massacred peaceful civilians who had evacuated the settlement of Ivanyan (Khojaly) in Artsakh, and then sought to blame the Armenian side at the state level.

Azerbaijan, which killed its own people, blames Armenians

The Azerbaijani government promotes the concept of "Western Azerbaijan," claiming that the territory of the Republic of Armenia is historically Azerbaijani and as if was originally inhabited by Azerbaijanis. However, historical evidence contradicts this assertion. Prior to the 20th century, the term "Azerbaijan" exclusively referred to Atropatene, a region south of the Araks River.

Azerbaijanis attempt to connect their history to the Kingdom of Atropatene, but the reality is different

Secondly, the Caucasian Tatars began to be called Azerbaijanis only in the 1930s. Thirdly, the region where the Republic of Azerbaijan exists today has historically been called Albania, Arran, Shirvan, etc., but not Azerbaijan.

Bakikhanov's "The Heavenly Rose-Garden" and the Azerbaijani falsifications

Via the promotion of this concept, Azerbaijan pursues several goals: attempting to annex the territory of the Republic of Armenia, diverting its own people's attention from numerous internal problems. Secondly, Turkey supports Azerbaijan in this issue, attempting to force Armenia and the Armenian people to forget about Western Armenia and the Armenian Genocide. Thirdly, through the settlement of Azerbaijanis in the Republic of Armenia, Azerbaijan and Turkey aim to provoke internal, interethnic problems in Armenia and subsequently interfere in the internal affairs of the Republic of Armenia. In fact, Azerbaijan is trying to change Armenia's demography by implementing this false concept.

''Return'' as a tool of Azerbaijan's hybrid attack on Armenia

Consequently, Azerbaijan advocates the repatriation of Azerbaijanis to the territory of the Republic of Armenia. However, Azerbaijan has yet to issue an apology to Armenians who were forcibly displaced from Azerbaijan or provide compensation to them. Furthermore, the Azerbaijanis who organized and perpetrated crimes against Armenians from 1988 to 2023 have not been held to account. The Azerbaijani authorities continue to sponsor cultural genocide, with the erasure of Armenian heritage in the territories under the control of the Republic of Azerbaijan.

In the current era of the 21st century, the Armenian nation and the Republic of Armenia are confronted with novel challenges. The borders of our state were delineated by external actors in a manner that has resulted in a rather intricate geographical configuration. While stable and friendly relations are maintained with our southern and northern neighbors, encompassing the Iranian and Georgian-Caucasian cultural spaces, unfortunately, the same cannot be said for our eastern and western directions. For two states that are important components of the Turkic world (Turkey and

Azerbaijan), the existence of Armenian civilization presents a significant obstacle to their long-term plans. Nevertheless, it is crucial to recognize that these states are our neighbors and that we must endeavor to normalize relations with them. The question then becomes: How might we achieve this? What mechanisms or methods might we employ to do so? Undoubtedly, finding solutions that align with the paramount interests of our state and are favorable to Armenia is of paramount importance.

Appendix

In November 2023, the National Academy of Sciences of the Republic of Armenia established the "Geghard" Scientific Analytical Foundation.

The main objectives of the foundation are:

- To conduct independent and reliable expert research in the fields of Armenian studies and social sciences for the society and the state, and popularizing its results
- To organize interdisciplinary scientific conferences, courses and workshops
- To organize popular scientific television and radio programs, publishing articles in the media on Armenian studies and social sciences
- To organize popular science lectures for university and high school student
- To identify and counter information flows that distort facts and historical event
- To Cooperate with international, regional, Armenian and Diaspora scientific, analytical and media organizations and individuals,The Foundation also publishes books and conducts scientific conferences, workshops and seminars where Armenian and foreign scientists and researchers address the aforementioned issues.

Capability Requirements for Effective National Security Planning

Hriar Cabayan

If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle. Appear weak when you are strong, and strong when you are weak.The supreme art of war is to subdue the enemy without fighting. Let your plans be dark and impenetrable as night, and when you move, fall like a thunderbolt.

Sun Tzu Quotes (544-496 BCE)

Background

Effective strategy and planning for national security requires a comprehensive diagnosis of the nature of the geopolitical landscape to inform choices. This is increasingly becoming challenging because interactive complexity in the geopolitical environment is accelerating, making simple "cause and effect" solutions increasingly difficult. In this instance, the Caucasus from a geopolitical standpoint is an example of such a complex environment that requires multi-disciplinary, mixed-method technical assessment approaches. The goal of these analyses is to expand strategic horizons and inform choices that lead to more effective strategy formulation.

The national security environment has become increasingly complex as the effects of globalization and power diffusion have allowed the entry of multiple new actors onto the global scene. Previously reserved to a few large nation-states, today's geopolitical reality comprises multiple players with greater ability to impact global affairs and whose interactions add to the security and regional risks. This new reality necessitates a deeper understanding of the landscape and the ability to use new analytical tools. These would enhance awareness of actors and their interests as well as clarify risks and opportunities pertaining to any situation. Such interactive complexity in the geopolitical environment is accelerating, making simple "cause and effect" solutions increasingly rare.

Facing complex operational and technical imperatives require collaborative, multi-agency, multi-disciplinary, mixed-method approaches. The goal is to expand strategic horizons and inform choices that lead to more effective strategy formulation for Armenia. This provides a diversity of thought and opinion by drawing on subject matter expertise from leading academics and practitioners from the public and private sectors globally. The goal of these analyses is to expand strategic horizons and inform choices that lead to more effective strategy formulation.

Given this complex geostrategic environment, there is a need to enhance creativity and insight in the planning process. In this context, Armenia needs approaches that play to its strengths. It has some distinct advantages amongst others:

- Armenia, including the diaspora, has a competitive advantage in training and unleashing a higher-tech workforce.
- The relatively open and free Armenian information environment is a relative advantage.

Requirements to meet these challenges

Effective strategy and planning require a diagnosis of the nature of the geopolitical landscape to informs choices. This will also include the “capability” landscape (i.e. technology, the Information ecosystem, etc.). Developing strategies to deal with these challenges will require multi-disciplinary, mixed-method technical assessment approaches for effective planning. Following are some key capabilities:

- The “capability” landscape (i.e. technology, the Information ecosystem, etc.)
- Cognitive Diversity is essential in the current environment
- Multi-disciplinary approach to problem solving
- Expanded strategic horizons for planners

Approaches to meet these challenges

Planners facing complex operational and technical imperatives require collaborative, multi-agency, multi-disciplinary, mixed-method approaches. There is a need to expand strategic horizons and inform choices that lead to more effective strategy formulation. There is a need for a diversity of thought and opinion by drawing on subject matter expertise from leading academics and practitioners from the public and private sectors globally. Conducting multi-disciplinary technical assessment of complex operational environments requires expertise and cognitive diversity. This necessitates leveraging a vast and highly effective network of SMEs from applicable agencies, policy centers, and academia both within Armenia and worldwide:

- Conduct multi-disciplinary technical assessment of complex operational environments that require expertise and cognitive diversity
- Leverage a vast and highly effective network of SMEs from applicable agencies, policy centers, and academia both within Armenia and worldwide
- Focus primarily on rigorous analysis given all available evidence
- Multiple approaches to avoid cognitive failures!
- No attempt to reconcile differences amongst SMEs (encourage diversity of thought)

Appendix

Critical Thinking for National Security – Strategizing and Planning course lays out foundational concepts and tools that would allow practitioners to address various challenges they face in today's security world. It introduces– the Interest, Resolve, Capability Framework (IRC)—a systematic analytic method for assessing multi-actor, highly uncertain, complex and challenging national security environments. The course also demonstrates the application of those tools through a pre-recorded simulation exercise conducted with a group of Subject matter experts using three hypothetical scenarios intended to assess future pathways for Armenia. Finally, the simulation exercise together with its generated final report, would allow a collective assessment of

their results and impact on Armenia's sectors, groups and communities. The course is available to all individuals or groups in interested in understanding national security concepts, their application and impact on Armenia

Course trailer: https://www.youtube.com/watch?v=vnCMpi5yLqM

Contact information: info@avc-agbu.org

Between Security, Technology, and Innovation
The Role of Social Sciences in Strengthening Armenia's Security Architecture

Nerses Kopalyan

The structural advances that Armenia's socio-economic system has made in accommodating and nurturing the rise of technology as a cultural phenomenon, technology as an intrinsic part of Armenia's economic growth, and technology as a crucial component for Armenia's progress in becoming a developed country, are acute developments that separate Armenia from most countries in the post-Soviet space. Much of this healthy synergy between the business and commercial sectors in accommodating and being consumed by the technology sector, while at the same time collaborating with the educational sector, with strong foundations in STEM, have created the fertile grounds to streamline Armenia's advances as a service-economy country with all the necessary and pertinent characteristics in making the country competitive and strong in the Information Age. Indeed, Armenia's immense and growing strength in embracing the digital age has offered this small, land-locked Republic a strategic advantage in both advancing its economic and commercial goals, while at the same time culturally integrating itself into the globalizing market. However, while the economic, corporate, and business configurations have successfully adapted and evolved into becoming pillars of Armenia's growth as a tech-savvy country, this growth has created a gap with respect to the role of other social factors. Namely, there's a vacuum in the conceptual structuration of Armenia's growth as a tech country: the role of the social sciences, and most importantly, political science, sociology, and security studies. These important fields have not so much been left out of the picture, but rather, they have not caught up to accommodate the growth of the technology culture.

In this context, while the business and private spheres have accelerated their engagement with the technological realm, state institutions, government organs, basic socio-cultural factors, and the non-STEM education sectors have struggled. In more simple terms, Armenia lacks a cogent and well-developed model in translating its success in the technology realm to one that also enhances and strengthens its security.

This struggle, however, is neither nefarious nor one of negligence, but rather, a natural and systemic byproduct of the long-held foundational problems that has been inherent to all countries having to overcome the institutions inherited from the Soviet legacy. As such, whereas the role and importance of social sciences has always and generally been excluded from the commercial, technological, and economic realms in Armenia, the more acute concern is the difficulty of properly aligning technological development and innovation with the policies and governance capabilities of government institutions. To this end, the social sciences can exponentially strengthen and support technological development and innovation in Armenia by offering the tools, governance models, policy-making capabilities, and the contours of functionality between technology and society. Understanding that security is not simply specific to physical security or hard power capabilities, the role of the social sciences in offering solutions and guidance to the synchronization of technological strength with comprehensive security and resilience remains crucial.

In the domain of support, the social sciences remain fundamental in underpinning the role of technology and innovation in enhancing Armenia's security capabilities, since Armenia is in the process of formulating three different approaches. First, it is in the nascent stages of developing a domestic weapons industry, which, inherently, assumes the intertwining of technology and security. Second, while a military-industrial complex is being formed, the processes, policies, and government procedures are also in the process of being formulated. And third, while technological innovation and the private IT sector has been leading the drive in marrying technology with security, at the end of the day, for this endeavor to work, the cogent functionality of the state's institutions, its pertinent organs, and its overarching security apparatus must be structured in a way that is conducive to collaboration and coordination. For all three of these approaches to work, support from the knowledge and research accumulated and developed by the social sciences remains imperative. More specifically, in order to be able to enhance Armenia's security architecture through the maximization of technological capabilities, the large body of knowledge and research from security studies must be applied to ensure both the short-term and the long-term success of the process.

In the realm of governance, policy-making, and institutional configurations, the role of political science, as a crucial field within the social sciences, remains fundamental. Since security studies is qualified as being a subfield of political science, for the sake of analytical parsimony, this report will qualify this subfield as such. The need to deepen, institutionalize, and systematize research capacities in political science in Armenia, while in parallel supporting pedagogy and professional development, is extremely important, because it is this field that produces government officials and civil servants, which are the two groups of people that will be guiding, supporting, and collaborating with the technology sector to strengthen Armenia's security architecture. At the same time, there is a very important democracy component: stronger a country's democratic attributes, the stronger its state institutions, and by extension, the stronger the level of cooperation and coordination between the private technology sector and the government. As such, there is an important sociological factor to the discussion as well: the strength and durability of any democracy rests on the ability and political will of its citizens to remain actively engaged in politics. But this also raises an acute, epistemological challenge. It can create the dangerous perception that politics cannot be studied with scientific tools, which is a sentiment that remains common among some Armenian analysts and even some scholars.

Thus, the false assumption that individual or collective opinion, minus deep methodological and scientific processes, is sufficient for political thought, and as such, for policy-making and governance, becomes a recipe for failure. Namely, the marriage of technology and security will be a categorical failure in Armenia if the social sciences are not integrated in the process. The trap remains straightforward: the former is viewed through the lens of STEM, while the latter is viewed through the paradigmatic lens of Soviet and post-Soviet thinking. Thus, the cyclical problem will remain unsolved: the IT sector will struggle to work with the government in marrying technology with security, because the latter lacks the sufficient training in the social sciences to be able to properly and functionally fulfill its responsibilities.

The confluence of democratization, democratic consolidation, and Armenia's security dilemma require the integration of the following subfields into Armenia's security thinking: comprehensive security, intersocietal security, small state resilience, and

hybrid warfare. All of these conceptual models also require an important component in order to be successfully implemented: technology and innovation. As such, Armenia's security cannot be separated from its innovative potential, and to this end, the success of this large endeavor necessitates the support and engagement of the social sciences.

But what does this precisely look like? How can we utilize research and findings from the social sciences, and more specifically, from security studies, and utilize this knowledge in supporting the integration of technology and innovation into Armenia's security architecture? What are the acute and specific security challenges that Armenia faces, and how can the social sciences support in finding answers and solutions to these challenges, and more so, how can these findings be used by the technology sector to further enhance their contributions to Armenia's security?

The prevailing body of literature on small state security offers extensive concentration on hybrid warfare, asymmetrical operations, gray zone tactics, and deterrence capabilities, with these essential subfields qualifying and empirically gauging the security configurations of small states in hostile neighborhoods. Further, studies demonstrate that the hybridization of war has made the concept of peace, definitionally, a relative concept, thus limiting the traditional binary thinking about the concept. Considering the 10-year trajectory of Azerbaijan's grand strategy leading up to the 2020 Artsakh War, a continuity of hybrid warfare and gray zone tactics defined a period falsely assumed as peaceful. In the realm of the asymmetrical phenomena that defines modern warfare, the traditional conceptualization of peace has no substantive meaning. Rather, developments and contextual understanding of security situations must be understood on a continuum: low-intensity hybrid warfare to high-intensity interstate militarized disputes. An empirical, quantified, and statistically articulated understanding of this continuum, and the wide range of variables and developments that inform and conceptualize it, are extremely important in producing a data-driven understanding of Armenia's security context, the modality of deterrence modeling that is compatible with Armenia's security needs, and the alignment of factors that are commensurate with developing a comprehensive security strategy. As a small democratic state functioning within a regional authoritarian orbit, the security dilemma faced by Armenia remains more acute than the security dilemma that is inherent to

most small states: Armenia's situation remains more precarious. Qualifying these assessments within a larger framework of security and technology, numerous questions are introduced:

1. How can technology and innovation enhance Armenia's hybrid and de-hybridization capabilities?

2. What role can technology play in giving Armenia asymmetrical advantages against Azerbaijan?

3. Can technology be one of the core pillars in developing Armenia's new deterrence capacities?

4. Understanding that the probability of peace, in whatever iteration, will still presuppose persistent and low-intensity conflict, how can technology and innovation allow Armenia to function and progress, while also mitigating its security problems?

While the technological realm can proceed in attempting to answer such questions from the lens of its technical sphere of knowledge, it cannot, however, cogently address these questions without the support of the social sciences. As such, the social sciences, on its own terms, will seek to provide answers to the following questions:

1. How can Armenia undertake de-hybridization and develop resilience against external threats?

2. What theories of deterrence are compatible with Armenia's small-state capabilities, and what probabilistic outcomes can be projected?

3. What is the relationship between resilience, de-hybridization, and successful implementation of comprehensive security?

4. What causal variables account for shifts in Azerbaijan's initiation of interstate militarized disputes, how can these be quantified into projective modeling, and what does the relationship between causal findings and projective outcomes indicate for strategic security planning for Armenia?

5. How is the failure of Armenia's reliance on pivotal deterrence theory to be reconciled by the empirical findings, and what is the success rate between deterrence-by-denial strategies and comprehensive security doctrines?

6. What variables shape successful alliance formations and what indicators should drive regional and international alliance formation for Armenia?

7. What is the relationship between the collapse of Armenia's security architecture, the dependency of its regional security arrangements, and projective outcomes?

8. What is the success rate of transitional democracies amidst security crisis and what do trajectories indicate for Armenia?

9. What variables account for democratic breakthroughs in authoritarian orbits and the consolidation of such nascent democracies facing exogenous threats?

10. What is the relationship between democratic consolidation, institutionalization, and successful implementation of resilience and comprehensive defense strategies?

11. What is the probabilistic outcome for small states, facing exogenous threats, to undertake a process of democratizing its security?

Let us imagine that the social sciences provide the answers to such questions. Now let us imagine what the technological sphere can do with this knowledge and data that has been produced. Further, let us imagine what policy-makers, government officials, and decision-makers can do with this body of research and findings produced. And finally, let us imagine if we can coordinate and collaborate the research, data, expertise, and governance best-practices into not only strengthening, but also innovating Armenia's security capabilities. To this end, and in no uncertain terms, Armenia cannot have security without technological development and innovation, but at the same time, it also cannot address its security problems without the support of the social sciences.

From Crisis to Accelerated Growth: Armenia's Economic Transformation

David Akopyan, Vasiliy Burov, Lev Freinkman

The Armenian economy has performed surprisingly well in recent years. From 2021 to 2023, the GDP growth averaged over 9%, remaining in double digits in the first half of 2024. However, many experts remain skeptical, attributing the growth to short-term factors like Armenia's trade benefits with Russia under sanctions. While recognizing the positive impact of various temporary factors, in contrast to this skeptical view, we argue that this growth acceleration is largely driven by significant improvements in economic fundamentals, creating a better chance to support robust growth over the medium term. Since the 2018 revolution, Armenia's growth model has become more sustainable and inclusive, a shift largely overlooked by experts and politicians.

Indeed, Armenia's growth acceleration is unexpected. On one hand, the country has faced well known development challenges: protracted regional conflicts, the blockade of major transport routes, deep-seated political divisions, widespread frustration, and migration. The debacle of the second Karabakh war in 2020 and the loss of Artsakh in 2023 were major blows to the nation's self-confidence, exposed strategic vulnerabilities of the country, and theoretically, further damaging investor sentiments. On the other hand, the current government in Yerevan, in the office since 2018, has done surprisingly little to boost investor confidence through a systematic effort to improve business climate by implementing necessary structural reforms and intensification of dialogue with the investor community.

The Game Changers

Two developments explain the growth acceleration. Both have evolved quite independently of the government's efforts to steer the country's development. First, the 2018 revolution brought economic freedom by dismantling oligarchic controls over business formation and growth. It reduced corruption and de facto deregulated the economy, opening new opportunities for business entry and expansion. Armenia's private sector responded strongly to these new market opportunities, leading to an

increase in the number of registered businesses, employment, and a strong recovery in net FDI volumes.

This "freedom dividend" led to a rise in budget revenues from an average of 20% of GDP in 2016-17 to 23% of GDP by 2023, largely attributed to the reduced incidence of corruption in tax and customs administration after 2018. Meanwhile, the number of registered SMEs in Armenia expanded by about 50 percent. Many businesses moved out from the shadow economy and joined the formal economy. In addition, with the realization that they no longer need protection (krysha), many perspective entrepreneurs, especially in the service sector, have been more willing to take risks and launch their own businesses. The accelerated pace of business creation led to a drastic decline in the unemployment rate – from 19.0% in 2018 to 13.5% in 2022 and down to 11.7% in 2023 - the lowest unemployment level in post-Soviet era.

For the first time in post-Soviet Armenian history, the people of Armenia have been able to fully utilize their traditional competitive advantages: entrepreneurial spirit, strong work ethics, professional excellence across various trades, and the effectiveness of global diaspora networks. For this to happen, the old structures associated with the previous regime just had to be moved out of the way, with little new institutional building taking place so far. However, without complementary policy steps, the growth dynamism released by deregulation and anti-corruption efforts may not be sustained indefinitely and is likely to be exhausted.

The second fundamental change in the Armenian economy relates to the new role of the high-tech sector, which has finally reached a critical size where its traditionally high growth rates (estimated at about 30% per annum for at least 25 years) have a significant impact on the overall macroeconomic dynamic and directly influence other sectors, reshaping the economic structure.

Armenian high-tech has advanced to a new stage, reflected in the rapid expansion in numbers and sophistication of local startups, the evolution of a supportive high-tech ecosystem, and the steady growth of R&D centers established by leading international corporations like NVIDIA and Synopsys. In 2022, Armenian startups raised $1 billion in deals involving top international venture funds. Picsart, the first Armenian unicorn, with

a capitalization of $1.5 billion and 150 million monthly users, became a role model for Armenian youth. The arrival of many high-tech professionals and companies from Russia since February 2022 further recognized Armenia's existing competitive advantages.

The IT sector in Armenia has never relied on government actions and support. Its success stems from a strong Soviet legacy and the persistent efforts of a relatively small group of entrepreneurs and corporate leaders, many from the diaspora. These individuals continued to invest and build partnerships over 30 years in a hostile environment, not expecting quick returns or recognition. The pre-2018 administration's corrupt and distortive policies had little impact on the sector, as the country's leaders failed to recognize the value of IT either as a potential long-term growth driver or as a source of personal gain. Now, Armenia is reaping substantial benefits from the decades of earlier investments in the sector, made against the odds and without any serious institutional support.

What is next?

Our analysis points to two groups of conclusions. The first is directed at the international community. We highlight the potential emergence of a new significant player on the global technology scene. Armenian tech companies already have a sizable footprint in several fast-growing market niches. They are well integrated in global value chains, having built strong links with US partners from their early days.

Strategic support from the West is crucial for Armenia to further solidify its position as a regional technology center and "island of freedom" in a challenging neighborhood. Armenia's transition from an over-dependent economy on Russia to a democratic state deeply integrated into global tech markets could also address the country's geopolitical challenges. Integration within the sensitive market segments of the economy of the global superpower should help Armenia enhance its security guarantees similarly to what happened in the past with Israel and Taiwan.

Support from the West would also involve enhancing Armenia's trade links and economic diversification. This may require advancing dialogue with pragmatic parts of

the elites in Turkey and Israel to reduce current anti-Armenian biases and dismantle the barriers to Armenia's regional and global integration.

The second group of findings is directed at Armenian politicians and the global Armenian elite. Our message is simple: "Wake-up! There is a promising window of opportunity for Armenia, but seizing it requires a more energetic and coordinated action". Armenia has a real shot at transforming its economy by leveraging its strengths in technology and entrepreneurship. The country is at a critical juncture, comparable to Israel in the mid-1990s or Taiwan in the early 1980s.

Recent progress has been encouraging and represents a solid foundation for attempting a developmental breakthrough. However, so far, high growth has occurred practically on its own, without much government contribution. This won't last long. For current trends to continue, Armenia needs to develop a state industrial policy, build new institutions, and expand participation in local, regional, and global partnerships. Comprehensive public administration and judicial reforms are necessary to ensure that the state can perform its core economic functions: protecting market competition, private property, and equal business opportunities, and enforcing smart regulations increasingly aligned with Armenia's main partners. Expanding investments in human capital, especially education, and strengthening the country's security guarantees are also vital.

The primary question is whether the country's leadership can wisely manage this opportunity. The strategy that is based on satisfying the populist pressures to address immediate public needs "here and now" will not work in this case. Instead, the country needs a transition to strategic and consultative decision-making, which so far has not been part of the governance tradition in Armenia.

If Armenia plays its cards right, it could join the ranks of successful countries like Israel, Taiwan, and Singapore, whose economic success is built on competitive advantages in the technology sector. While luck and international goodwill would be helpful, the real key to success lies in intelligent policy choices by Armenian elites and disciplined execution.

ARMENIAN WOMEN AS TECHNOLOGY ENTREPRENEURS

Arpie G. Balian

The concept of technological entrepreneurship has gained increased momentum in recent decades among policy-makers, business leaders, innovators, and governments. Researchers engaged in studying the phenomenon have considered a multitude of factors that spark technological entrepreneurship, including state regulatory and institutional strategies, operating environment, and triggers of value creation within the corporate and non-profit sectors. Whereas no standard definition of the term has yet evolved, the dominant understanding of entrepreneurship is that it involves the recognition and pursuit of opportunities for creating public value. Typically, this translates into generating new prospects for growth and development, especially in specified fields in respective developing country(ies). Yet the benefits of modernization and digitalization are not derived easily and women across the world and especially in the developing world still face multiple obstacles they must overcome to succeed in the digital economy.

Despite these challenges, women entrepreneurs have increasingly joined digital platforms considering the fact that these present low technological barriers to entry. In that context, the rise of digital technologies appears to have spurred female interest and involvement in entrepreneurship, while catching the attention of scholars to the study of women's entrepreneurship and the examination of gender disparities in digitized endeavors. Notwithstanding this growing attention, there is little empirical evidence on the benefits derived by female entrepreneurs from digital platforms or the extent to which they have leveraged digital technologies in comparison to their male counterparts and whether or not female entrepreneurs are encountering comparable or reduced levels of gender bias to start and grow their businesses. Anecdotally, there is no evidence that the picture in Armenia is any different.

Researchers claim that as more women work in the tech sector, it is likely that they will build the right level of expertise to launch their own tech startups. Extending their digital knowledge further by way of providing access and appropriate devices to lower-income females may prove to be more effective and produce higher impact. At the same time, state level policy regulations of developing countries that require

companies to hire women on the basis of a minimum quota might also produce measurable results, although such measure should be in the form of sunset laws imposed over a limited period of time. Governments could consider offering tax incentives to companies in the tech sector that promote and embrace gender equality. Even in the U.S., there are claims that only 24 percent of workers in the technology sector are female, though these statistics have measurably improved since then showing women's participation at 47% in 2023 and projected to remain steady over the next decade. Slightly differently, "*Deloitte Global predicts that large global technology firms, on average, will reach nearly 33% overall female representation in their workforces in 2022, up slightly more than 2 percentage points from 2019*" (Hupfer et al., 2021). There is a dominant recommendation for developing countries to consider adopting gender-driven hiring policies whereby companies give women priority opportunities to spark their participation in the technology sector, provided such gender advantages do not permeate into the business culture but are only exercised over a short period of time.

In view of the continuing gender gap and considering recent trends in technological entrepreneurship, it is noticeable that women entrepreneurs in developing countries are making concerted effort to carve out or expand their spaces in the traditionally male-dominated business sector. More and more women entrepreneurs across the world are guiding companies, small, medium and large, to measurable success. On a global scale, this phenomenon is visible in women's growing engagement in technological entrepreneurship. Particularly in STEM fields, but in technology entrepreneurship more specifically, the growth of entry level opportunities and female role models is sure to lead to sustainable development outcomes by women entrepreneurs. Turning attention onto Armenia's development, heavily dominated by males as in many other developing or underdeveloped countries, women's involvement in technology entrepreneurship is starting to show an increase, albeit slow and small, that merits further attention.

This research identifies the dominant obstacles to women's involvement as technology entrepreneurs in Armenia's economy, along with a review of the advantages they could bring to the table given an impartial acceptance of their expertise irrespective of gender. The observations for the current research have shown that despite the

hardships Armenian women have faced, they've made progress in the technology industry, many of whom have even excelled at entrepreneurship overcoming gender discrimination, believing in their personal abilities, hard work, determination, and pursuit of excellence. However, despite those individual successes and the advances made by women in educational pursuits, women in leadership positions continue to be underrepresented. This male-dominated economic advancement could burgeon by women's involvement in entrepreneurial initiatives.

Within that framework, this research builds upon Drucker's (1985: 49) argument that entrepreneurs practice systematic innovation, which constitutes "*the purposeful and organized search for changes, and in the systematic analysis of the opportunities such changes might offer for economic or social innovation."* In that context and conditioned by the potential in developing nations such as Armenia, technological entrepreneurship must gradually assume a more important and essential place in the state economic agenda. The example of other countries has shown that such a focus would require the intense attention and effort by the government of Armenia. Accordingly, it becomes important to ask what the role of government is or should be in fostering the growth of an entrepreneurial ecosystem? How would such a growth advance the involvement of women entrepreneurs in development? Would policy alternatives grow women's technological entrepreneurship further enhancing their sustained contribution to development?

What then are the lessons to learn from governments of developed countries that provide significant support for research and development in various technological fields? It is evident that such support is generally manifested in funding for research, adoption of policies to create an environment conducive to research and technological advancement, strategic investments in technology that align with the respective country's strategy for economic growth. Such comprehensive government support is not true for developing nations such as Armenia that fall short of adopting a strategy of infrastructure support that pays priority attention to attracting women into technological entrepreneurship. Moreover, contrary to developed countries with high levels of state capacity, in developing states such as Armenia with limited state

resources, government involvement in innovation and entrepreneurship focused on women is rather insubstantial.

Considering the complex and changing relationship among market, government institutions, and entrepreneurship, developing countries must focus on building the big-picture institutional capacity to instigate or amplify innovation through policies that facilitate and/or promote entrepreneurship to set it in the right direction (Peters et al., 2005) and maintain an upward trajectory. Particularly from the standpoint of involving women, state institutions could act as catalysts of entrepreneurial ventures and as initiators of entrepreneurial opportunities (North, 1990). As such, governments could create an environment conducive to supporting technological entrepreneurship (Bruton et al., 2010), especially among women. This would assume a role for government as coalition builder among public, private, and nonprofit agencies to collectively pursue a shared policy agenda.

Theories of entrepreneurship focus mostly on the criticality of appropriately and comprehensively identifying available growth opportunities, whereas the socio-cultural theory of entrepreneurship put forth by Hofstede (1993) argues that entrepreneurs develop in countries with developed societies. He claims that culturally developed segments or groups in a given society are likely to become the driving force behind entrepreneurial initiatives and, therefore, greatly contribute to economic development. This is particularly true for the tech sector. As such, the psychological theory of entrepreneurship argues that entrepreneurs are driven by personal motives and incentives of achievement (McLelland and Winter, 1971). The most important motivation behind technological entrepreneurship is that of accomplishment (Davidsson, 1989) and personal fulfillment. Looking at the business environment with that lens demonstrates that entrepreneurial activity is sparse and visible in small pockets that can be described as culturally developed segments of Armenian society.

Within that context and in view of traditional economic theory, pursuit of additional income still is the main trigger behind entrepreneurial activity, which is often regarded as less intense in the case of women entrepreneurs in Armenia. Though there is no statistical evidence that women strive for success no less than men, there are anecdotal studies that claim that women often project self-doubt, which often holds

them back from taking the next step in entrepreneurship, especially technological entrepreneurship. When a business project goes wrong, perfectionist women (more dominant among women) are more likely to blame themselves. Yet when something goes right, they more often credit others or circumstantial factors for their success (https://www.bing.com/ck/a?!).

To delve into the factors affecting women's interest in technology entrepreneurship, the study used interviews to investigate the underlying phenomena that drive entrepreneurial success, also looking into non-obvious factors that have or could have made a difference in women's entrepreneurial journey. Overall, five female business leaders were interviewed, as well as five male counterparts. This allowed for a comparison of the differences attributable to gender and gender-related factors. Additionally, a qualitative survey was conducted among women interested in, or studying to enter the technology sector, similarly allowing for a comparison against the qualitative data collected from women who were accomplished entrepreneurs.

The findings have shown that at the individual level governmental agencies could help drive a culture of entrepreneurship by raising technological knowhow among women by way of boosting their entrepreneurial skills and availing them startup incentives, as expressed by all five of the businesswomen, as well as two male business leaders interviewed. At the lower enterprise level, policy considerations for promoting women's entrepreneurship could/should consider private sector involvement using various models that are innovative, participatory, and have built-in components for encouraging women in business. At the national macro level, Armenia's legal framework and policy considerations could be improved to create the necessary infrastructure while creating incentives that elevate women's interest in technological entrepreneurship.

Just as in other developing countries, several interviewees posit that gender roles for women in Armenia are changing in a few major cities where their participation in business is viewed more constructively. Similar to findings in other countries, women in Armenia are more collaborative and compassionate than men, which are qualities that are particularly important leadership characteristics. Here too, the government of Armenia must move faster towards enabling an environment where private businesses,

as well as community-based and non-profit organizations grow interest in technological issues and/or are attracted to assuming a greater role in empowering women. It has become even more important that policy measures in Armenia aim at upgrading women's entrepreneurial education and training, as well as growing among them a culture of participation in governance and government.

Among the other findings from the interviews is the emphasis that the Armenian government should implement state-funded programs focused on growing the entrepreneurial ecosystem. As such, Armenia must focus on creating conditions and infrastructure that would particularly promote entrepreneurship, feasibly technological entrepreneurship among younger adults, the segment of the local population visibly attracted to and interested in technology. As part of this state-level effort, 8 business leaders (5 female and 3 male business leaders) indicated the urgency of training and retraining state employees in various topics of significance to technological development paying particular attention to circumvent male domination in these courses.

Numbers from the 2022 state-published statistics reveal that 30%-40% of IT sector employees in Armenia are women, compared to the global average of around 25% in the same year (Civilnet online 21 July 2023). As impressive as this may look, public and private sector organizations in Armenia must pay increased attention to increasing women's engagement in the economy as technology entrepreneurs. In this context, the government could assume the role of fostering the growth of the entrepreneurial ecosystem, paying close attention to advancing the involvement of women entrepreneurs in development. Also, the government must get engaged in women's entrepreneurial initiatives so as to magnify and extend the scale of their impact more broadly through access to state institutions and adoption of policies that increase state support and facilitate entrepreneurship.

To grow women's participation further "*We need more women mentors and role models to inspire the next generation and create a more inclusive and diverse IT community*," says Mariam Torosyan, Founder and CEO of SafeYOU, a multi-stakeholder mobile application and platform designed to empower women and raise awareness on key gender-based issues. This advice fittingly wraps up the opinion of those interviewed

and maps out the way forward for growing women's involvement in Armenia's economy. In the absence of rules and regulations that encourage women's participation in the technology sector, the overwhelming majority of those interviewed posits that the government should periodically assess the impact of its strategies for growing technology entrepreneurship in Armenia and accordingly design action improvements that would increase impact. The majority opinion was to strengthen state-sponsored programs directed at growing the technological knowhow of women and endorse their leadership in technological entrepreneurship.

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An Armenian Woman’s Experience in the High-Tech Sector

Anzhela Baltayan

Introduction: Context and Importance

In recent years, Armenia's high-tech sector has emerged as a crucial pillar for the nation's economic development and security. With a growing emphasis on technology and innovation, the country has sought to leverage its intellectual capital and global diaspora to bolster its competitive edge. However, the high-tech industry in Armenia is not just a domain for economic growth—it is also a strategic area that plays a vital role in strengthening national security.

As Armenia faces ongoing regional challenges, the development of a robust high-tech sector is essential to maintain its sovereignty and security. This sector is not only about technological advancements but also about empowering individuals, particularly women, who are often underrepresented in this field. Women like Anzhela Baltayan, the Executive Director of the Gyumri Development Laboratory Foundation, are at the forefront of this movement, driving innovation while breaking gender barriers (CivilNet, 2023).

Anzhela's journey in the high-tech sector is a testament to the resilience and potential of Armenian women. Her experience sheds light on the importance of inclusivity and diversity in technology, highlighting how empowering women in this sector can contribute to Armenia's broader national interests.

Personal and Professional Journey

Anzhela Baltayan’s professional journey is marked by a diverse range of roles and achievements that underscore her commitment to advancing technology and education in Armenia. Currently serving as the Executive Director of the Gyumri Development Laboratory Foundation since May 2021, Anzhela has significantly impacted the high-tech sector through her leadership and innovative initiatives. Her background includes roles such as Contest Coordinator at the Ayb Educational Foundation, Lecturer of Chemistry at the National Polytechnic University of Armenia,

and Head of the Training and Methodological Support Department at the Shirak Regional Pedagogical-Psychological Support Center.

Anzhela's expertise extends beyond traditional high-tech roles. She has worked as a mentor-trainer for inclusive education and an expert in local-level advocacy on health and educational entitlements. Her role as an instructor in chemical warfare agents' detection and analysis reflects her technical proficiency and dedication to advancing specialized knowledge.

Gender-Specific Obstacles

Despite her extensive qualifications and leadership roles, Anzhela has faced significant challenges as a woman in Armenia's high-tech industry. The sector, traditionally dominated by men, presents barriers such as gender bias and a lack of female role models. Anzhela's experiences are a testament to these challenges; she has navigated a landscape where her contributions often had to be proven repeatedly to gain recognition (CivilNet, 2023; ARKA, 2020).

Cultural expectations in Armenia also pose obstacles for women pursuing careers in technology. Societal norms and stereotypes can limit opportunities for women and hinder their professional advancement. Anzhela's ability to overcome these hurdles highlights the need for continued efforts to promote gender equality and support women in high-tech fields (UNSDG, 2022).

Her journey illustrates the broader systemic issues faced by women in technology in Armenia and emphasizes the importance of creating a more inclusive and supportive environment to harness the full potential of female talent in the sector.

Key Contributions and Impact

Under Anzhela Baltayan's leadership, the Gyumri Development Laboratory Foundation has become a cornerstone of technological innovation and education in Armenia. Anzhela has spearheaded several key projects aimed at advancing the high-tech sector and addressing national security challenges.

1. **Smart Sort Project**: One of the foundation's flagship initiatives, the Smart Sort project, is a testament to Anzhela's vision of integrating cutting-edge technology with practical applications. This project, which involves developing advanced sorting systems using robotics and artificial intelligence, not only showcases the foundation's technological capabilities but also aligns with Armenia's national security by enhancing local technological expertise and creating solutions that can be critical in various security contexts.

2. **Robotics and STEAM Education**: Anzhela has prioritized the development of robotics and STEAM (Science, Technology, Engineering, Arts, and Mathematics) education programs. By establishing state-of-the-art labs and organizing competitions, she has fostered a culture of innovation among young students. These educational initiatives aim to build a skilled workforce capable of addressing both current and future technological needs, thereby contributing to Armenia's broader technological and security objectives (CivilNet, 2023).

3. **Collaboration with International Partners**: Anzhela has successfully facilitated collaborations with international STEM organizations. These partnerships have provided valuable resources and expertise, further advancing the foundation's projects and integrating global best practices into local initiatives. This international collaboration also enhances Armenia's global tech presence and strengthens its ability to address security challenges through advanced technology (ARKA, 2020).

Empowering the Local Community

Anzhela Baltayan's efforts extend beyond technological projects to include significant community empowerment initiatives. Her work is focused on leveraging technology to improve the lives of local residents and contribute to national security.

1. **Inclusive Education Programs**: Anzhela has championed inclusive education programs that provide access to technology and educational resources for underprivileged communities. By offering training and resources to underserved groups, she ensures that all individuals have the opportunity to participate in and benefit from technological advancements.

2. **Local Technology Workshops and Training**: The foundation regularly hosts workshops and training sessions that bring technological knowledge and skills to the local community. These initiatives not only enhance individual capabilities but also strengthen the local tech ecosystem, creating a more resilient and informed community.

3. **Support for Women and Youth**: Recognizing the importance of gender equality and youth development, Anzhela has implemented programs specifically designed to support women and young people in technology. By providing mentorship, training, and career development opportunities, she helps to bridge the gender gap and inspire the next generation of tech leaders (UNSDG, 2022).

Anzhela's contributions through the Gyumri Development Laboratory Foundation exemplify her commitment to integrating technological innovation with community empowerment. Her work aligns with Armenia's national security goals by fostering a technologically skilled workforce, promoting inclusivity, and enhancing the country's capacity to address emerging challenges.

Mentorship and Female Empowerment

Anzhela Baltayan has played a crucial role in mentoring and supporting women and educators in the tech industry. Her efforts are reflected in several key areas:

1. Mentorship and Training Programs

- **Support for Emerging Robotics Trainers**: Anzhela has mentored Shushanna Gevorgyan and Lyuba Zilfimyan, both of whom became robotics trainers while still students. Her guidance helped them develop their skills and pursue careers in tech education, contributing to the growth of the robotics community in Armenia.

- **Teacher Training and Supervision**: Anzhela has provided extensive training and supportive supervision to STEM teachers. Her initiatives focus on modernizing teaching methods and integrating technology into the classroom. This includes hands-on training in contemporary tech tools and

teaching methodologies, enhancing the quality of STEM education in Armenia.

2. Success Stories

- **Robotics Trainers**: Shushanna Gevorgyan and Lyuba Zilfimyan, who were mentored by Anzhela, have become influential robotics trainers. Their roles as educators in robotics not only reflect their personal achievements but also contribute to the broader development of the tech sector by training the next generation of tech enthusiasts.
- **Impact on STEM Education**: Anzhela's work with STEM teachers has led to significant improvements in educational practices. By helping educators adopt modern teaching methods and incorporate technology into their lessons, she has elevated the overall quality of STEM education in Armenia.

Broader Impact on the Tech Sector

Anzhela's efforts in mentorship and female empowerment contribute significantly to the overall strength and inclusivity of the tech sector in Armenia:

1. Promoting Gender Diversity

- Enhanced Female Participation: Through her mentorship and training programs, Anzhela has increased the representation of women and girls in tech fields. Her work encourages more female participation, leading to a more diverse and innovative tech community (ARKA, 2020).
- **Inspiring Future Leaders**: Anzhela's role as a mentor and supporter serves as an inspiration for women and girls interested in technology. Her success demonstrates the potential for women to thrive in tech, challenging existing stereotypes and opening doors for future leaders (CivilNet, 2023).

2. Strengthening the Tech Ecosystem

- **Inclusive Educational Practices**: By modernizing STEM education and supporting teachers, Anzhela enhances the tech ecosystem's ability to foster talent and innovation. Her contributions help build a more capable and adaptable workforce, essential for addressing future technological and security challenges.

- **Sustainable Development**: Anzhela's focus on integrating technology into education and mentoring educators ensures long-term benefits for the tech sector. Her initiatives contribute to a continuous pipeline of skilled professionals and a robust, inclusive tech community.

Vision for the Future

Anzhela Baltayan envisions a future where women play a pivotal role in Armenia's high-tech sector, driving innovation and contributing significantly to national security. Her vision includes:

1. Expanding Female Participation

Increased Representation: Anzhela aspires to see more women occupying leadership and technical roles within the tech industry. By continuing to mentor and support women in tech, she aims to close the gender gap and ensure that women's contributions are recognized and valued.

Encouraging STEM Education: Anzhela advocates for the integration of STEM education at all levels, with a particular focus on encouraging girls to pursue careers in technology. Her vision includes creating more opportunities for girls to engage with technology from a young age, building a strong foundation for their future careers.

2. Fostering Innovation and National Security

Strengthening the Tech Sector: Anzhela's future initiatives will focus on advancing Armenia's high-tech capabilities, contributing to both economic growth and national security. By leveraging technology to address critical

challenges, she aims to position Armenia as a leader in technological innovation within the region.

Conclusion

Anzhela Baltayan's experience in the high-tech sector exemplifies the potential and challenges faced by women in Armenia. Her contributions to technological innovation, mentorship, and community empowerment demonstrate the critical role women can play in advancing the tech industry. Anzhela's work not only strengthens Armenia's tech capabilities but also contributes to national security and economic development.

As Armenia continues to navigate regional challenges, the inclusion and empowerment of women in the high-tech sector will be essential for building a resilient and innovative nation. Anzhela's vision for the future underscores the importance of diversity, education, and collaboration in achieving these goals. Her leadership and dedication serve as an inspiration for future generations of women in tech, paving the way for a more inclusive and prosperous Armenia.

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Role of Academic Institutions in Advancing Technology in Armenia

Armen Der Kiureghian

Introduction

Many prerequisites are necessary for a country to achieve an advanced status in technology. These include government policies that incentivize technology development, availability of necessary means for communication and transportation, ease of collaboration with international organizations, and access to international markets; but most critically, it is the availability of manpower with the right education, training, and skills. Academic institutions, from elementary to secondary schools to universities, have a critical role in preparing this manpower.

This article discusses the role of academic institutions in advancing the technology sector in Armenia – a small, landlocked country in a troubled neighborhood, but with a long tradition of excellence in education, science and technology. We discuss the types of education and training that are needed and the skills that are critical in advancing the technology sector, as we also discuss the types of technology advancement that is desirable.

Technology Development

During the Soviet era, Armenia was heavily involved in technology and industrial development, including the manufacturing of computers, laser-guided systems (primarily for Soviet defense purposes), production of high-precision machinery and automobile parts, and other products, all in collaboration with other Soviet republics. After independence in 1991, these collaborative linkages were severed. Furthermore, due to lack of access to a seaport and blockade by two of its neighbors, the means for transportation of manufactured items were severely limited. As a result, the direction of technology development in independent Armenia changed so that Information Technologies (IT) became the dominant domain. Work in IT does not require physical transportation of goods and much of it can be done through electronic communication, thus not being affected by the limitations posed by the landlocked nature of the country.

In the early years of independence, due to blockades by Turkey and Azerbaijan, Armenia went through an extremely difficult time with lack of electric power, water, and food resources, as well as work stoppages and high levels of unemployment. As a result, large numbers of the leaders in technology fields left the country. It took more than ten years for the country to recover and restart activities in technology. At first, international IT companies (mostly owned by diasporan Armenians), opened offices in Armenia, essentially outsourcing their development departments. A major breakthrough occurred when Synopsys, an electronic design automation company headquartered in Silicon Valley, opened a branch in Yerevan, now employing more than 1,000 IT specialists. Many other American companies set up offices in later years, one of the most recent being NVIDIA, a world leader in artificial intelligence computing.

Today, there are two types of IT companies in Armenia: Those that are branches of international (mostly American) companies, and those that are locally established though typically providing services worldwide. The first group of branch companies essentially provide outsourcing services to their respective headquarters. Though these companies provide salaries to their employees that are well above the typical Armenian salaries, they usually offer limited opportunities for innovation and advancement in the field. The local employees essentially carry out development work that is assigned by the firm's headquarter office with little leeway in exercising creativity and innovation. Furthermore, the main profit from the work done is made by the company headquarter where marketing and sales are carried out.

Home-grown companies are conceived and established in Armenia, though they may have offices abroad. They control the intellectual property rights of their products and are the main beneficiaries of the gained profits. Given the small market in Armenia, any home-gown IT company must develop an international market to be profitable. Fortunately, the development of electronic communication and media resources facilitates this process. Today, there are tens of successful home-grown companies and thousands of aspiring small startups in Armenia. Notable examples of highly successful home-gown IT companies include PicsArt, a Unicorn company that provides online photo and video editing applications, and Krisp that offers noise-suppression technology.

While the outsourcing companies are essential for developing the IT field and contributing to the economic well-bring of the technology sector in Armenia, the country cannot be considered a technology hub without successful home-grown companies.

The Role of Education

Education has a critical role in preparing the needed manpower for the technology industry and, indeed, for any creative and productive venture in a country. At the school level, it is essential to provide the fundamentals in reading and writing, the humanities and arts, and the basics of mathematics and sciences. Equally important is instilling the love of learning and the habits and discipline necessary for acquiring knowledge, and preparing students for university education.

Education at the university level should aim at preparing citizens with broad as well as specialized knowledge, coupled with skills for inquiry, judgment, and communication, as well as life-long learning. However, the needs in technology as well as other industries and work environments are diverse and multipronged. For example, outsourcing technology companies need specialists in narrow domains of application, while establishment of home-grown companies needs individuals who are innovative and think outside the box. This implies the need for different types of education at the university level. Here, I will bring the example of the public higher education system in California, which is designed to meet the diverse needs of the technology and other professional fields in the state.

The public higher educational system in California consists of three systems of universities and colleges: the University of California (UC) system, the California State University (CSU) system, and the Junior College (JC) system. Universities in each of these systems are designed to meet specific needs of industry and professional/governmental organizations within the state.

The UC universities offers high quality education with emphasis on theoretical fundamentals as well as essential practical topics. Every student is required to have general education courses to acquire a breadth of knowledge and soft skills. Opportunities for research are made available at the undergraduate level and required

at the master's and doctoral levels. Graduates from these programs are well suited for positions that require continued inquiry and innovation and provide opportunities for advancement and leadership. The graduates often are not well-suited for positions that require narrowly scoped applied work, for which they have not taken courses. But due to their strength in the fundamentals and breadth of knowledge, they tend to be quick learners and manage to catch up in a short time. More importantly, benefiting from their strength in the fundamentals, they are able to shift direction and venture into new domains of development and application as technology advances. Furthermore, thanks to their soft skills acquired through general education courses, they tend to be good communicators and possess leadership qualities.

The CSU universities offer education with more emphasis on the practical needs of industry and other professions. These universities do not require research and do not offer doctoral degrees. They tend to train their students in details of applied work (codes of practice, design and implementation methods, applicable rules and regulations) so that they are ready to immediately engage in work in industry and other professions. In this sense, graduates from these universities tend to do well as productive employees within a short time after being hired. On the other hand, they tend to be less likely to shift directions, engage in innovative ventures, or advance to leadership positions.

In short, the UC system produces the leaders of the professions, while the CSU system produces the masses of workers that the professions need to produce their products. Obviously, these categories make sense only in a statistical sense. That is, graduates from UC system are more likely to become leaders, while graduates from CSU system are more likely to become productive workers performing under leadership. Surely, many exceptions occur in both categories. However, the point is that the system is designed to meet the needs of the industry and professions for both innovators and leaders and for workers in production.

The JC system is designed to meet the needs of late bloomers, i.e., those who decide to pursue higher education later in life, those who are not admitted into UC or CSU, and those who wish to attend higher education near their homes. JCs offer two-year

programs with an associate degree, after which the student may pursue higher education in either the UC or CSU systems.

The Role of Educational Institutions in Armenia

The educational system in Armenia has a critical role in preparing the needed manpower for the technology and other professional or governmental sectors in the country. As mentioned earlier, this need is diverse and multi-pronged. There is a need for workers who produce the products offered by these sectors, and there is a need for innovators and entrepreneurs who create new ventures and products. In between, there is a need for managers who can lead the workers and assure profitability of the products and new ventures. To achieve these goals, every segment of the Armenian educational system has a role to play.

As mentioned earlier, the school system has an important role in preparing students for entry into the higher educational system. Unfortunately, the quality of schools in Armenia has sharply deteriorated since independence, particularly in providing high-quality education in basic mathematics and sciences that are critical for careers in technology. In particular, many high schools in provinces are unable to offer the math/science track due to lack of qualified teachers or lack of interest among students. This is ironic, since during the Soviet time mathematics and sciences were highly preferred paths for pursuing future careers. The majority of parents, who have domineering roles in the selection of their children's tracks in high school, prefer that their children pursue humanities or economics/business tracks. While these are important tracks, education in mathematics and sciences is essential for a country that aspires to advance in technology.

The vast majority of teachers in Armenian schools are graduates of the State Pedagogical University. Unfortunately, the quality of graduates from this institution, particularly in mathematics and sciences, is far from being satisfactory. Graduates from Yerevan State University (YSU) with degrees in mathematics or sciences are far better prepared in these fields, yet they cannot be hired as schoolteachers unless they go through pedagogical training. Furthermore, schoolteachers with strong math and science backgrounds are able to find better paying jobs in the technology sector.

Hence, reform in training, certification, and better salaries for schoolteachers are areas that require improvement to help advance technology in Armenia. In recent years, with support from the U.S. Embassy, the American University of Armenia has established a training and certification program for STEM (Science, Technology, Engineering, Mathematics) teachers in high schools. Other programs by ARPA, the Armenian Educational Foundation, and other organizations are also underway. However, far more is needed to improve the mathematics and sciences programs in Armenian schools. Specific interventions and investments by the Armenian government are essential.

YSU provides strong programs in mathematics and sciences. However, students in these programs are narrowly trained. They take all their courses within their departments and have little opportunity to interact with students from other fields. In comparison to the California system, YSU is similar to the UC system in its focus on fundamental mathematics and sciences, but it does not provide the breadth of knowledge and soft skills that are necessary to prepare innovators, leaders, and mangers of technology companies.

The National Polytechnic University (NPU) essentially provides practical training similar to the CSU system, but again narrowly defined and devoid of general education requirements and provision of soft skills. Graduates from NPU essentially serve as production workers.

Unfortunately, course materials both in YSU and NPU are often outdated and both universities are having difficulty recruiting new faculty with modern training. Meager salaries are one impediment in recruiting qualified faculty.

Several IT companies in Armenia have become involved in university programs. Notable among them is Synopsys that has established a program, whereby selected students from YSU and NPU are taught by the employees of the company during the last two years of their undergraduate program. This type of practice would not be allowed in California universities. As one can expect the training in this kind of program can be narrowly focused on the needs of the sponsoring company, rather than a broadly scoped education appropriate for a growing and diverse technology sector.

The Russian-Armenian University (RUA), the French University in Armenia (FUA), and the American University of Armenia (AUA) offer alternatives to the programs in YSU and NPU. They provide more up-to-date courses, some taught by international faculty. However, the programs at RUA and FUA are again narrowly constructed and lack breadth beyond the field of study, typical of the Russian and European approach to higher education. All three universities as well as YSU and NPU provide opportunities to their students for internships in the industry during the course of their studies. Furthermore, because of the high need in the industry, many students in IT fields are employed during the course of their studies.

The AUA has three undergraduate programs related to technology: BS in Computer Science, BS in Data Science, and BS in Engineering Sciences. These programs require around 120 semester units, including a capstone or thesis. More than one fourth of these units must be in general education courses and the remainder in required fundamental math and science courses and in required and elective specialization courses in the major. Students take the general education courses with students from other fields. This helps broaden their educational experience and improve their skills for interaction and communication with specialists in other fields. Elective courses in the major provide an opportunity to achieve diverse specializations, depending on the interests and strengths of each student. Overall, the AUA programs are similar to those in UC campuses. With their depth and breadth of education, AUA graduates are well prepared for entrepreneurial and leadership/managerial positions in the technology sector.

Research conducted in universities is another important function to advance technology. Doctoral programs are offered by YSU, NPU, RUA, and the institutes of the National Academy of Sciences. At the present time, AUA does not offer doctoral programs, but some students at both undergraduate and master's degree levels conduct supervised research on applied topics. Unfortunately, most doctoral research topics in Armenian universities are purely theoretical in nature and often irrelevant to the needs of technology industry. This is partly because, unlike in the U.S., technology firms in Armenia seldom provide funding for research in universities. Such funding for

targeted topics in technology can bring about a much needed collaboration between the technology sector and the universities in Armenia.

Recently, a group of American-Armenian academics have advocated the establishment of a foundation to facilitate and support collaboration among Armenian and American researchers in science and technology fields. The foundation would provide financial support to the Armenian counterpart, while the American counterpart would receive support from U.S. funding agencies, such as the National Science Foundation, both on a competitive bases through objective review of proposals. Given the small size of Armenia, such collaboration with international colleagues would be of extremely high value in advancing the level of science and technology in Armenia. Currently, effort is underway to establish this foundation with support from the Armenian and American governments.

Role of the Diaspora in Advancing the Technology Sector in Armenia

Hagop Panossian

Overview

Armenia has a growing information and communications technology (ICT) sector. Specialists in software development, computing, electronics, design and semiconductors in Armenia work in numerous global companies. The ICT sector has shown respectable growth and continuously expanding workforce, as Armenia is moving towards a more meaningful role in the global technology world. There are over 3,500 companies in ICT with more than 24,000 employees, benefitting Armenia with their more than one billion dollars annual income. Currently ICT is growing at about 21% annually and may increase due the numerous new foreign high-skilled ICT workers from Russia and Ukraine. These are all of particular interest to Armenia as ICT companies explore opportunities to sustain aggressive growth.

The government of Armenia has had an active role in supporting the development of ICT by working with international investors, to improve the sector for higher global impact and to transform Armenia into a digital society, through advancement in innovative technologies, cyber security, data policy, e-government systems, digitalization processes, and by creating common standards, according to the latest World Bank report. Armenia boasts with its deep talent pool in mathematics and sciences, language proficiency, improving university programs, competitive labor and operating costs. Not any less important is the government support for the sector, a strong high tech diaspora network, and relationships with large multinational companies as part of global value chains.

The successive governments of Armenia have given broad support behind the development of the high-tech landscape of Armenia. The government has long identified the sector as a priority, signing numerous memoranda of cooperation and agreements with foreign governments and multinational companies. The government is focused on moving Armenia increasingly to a digital society. It approved the Digitalization Strategy adopted by the government in February 2021. The strategy envisages digital transformation of the system of Governance, the economy and the

society through the introduction and development of innovative technologies, cyber security, data policy, e-government systems, coordination of digitalization processes, and the creation of common standards.

Diaspora Participation

Several major events attracting international attention have been organized in Armenia. Some examples of these are the 2019 World Congress on Information Technology, which will repeat in 2024, the FAST Global Innovation Forum, the ArmTech conference organized by the Enterprise Incubator Foundation, the annual DigiTec conference organized by the Union for Advanced Technology Enterprises, as well as the annual Engineering Week. In all these Diasporan experts have played a significant part, either as co-organizers, participants or financial backers. However, as Armenia slowly moves up the value chain and tries to remain competitive in ICT, several emerging fields and opportunities are on the horizon. According to the World Bank report, the extent Armenia can succeed in becoming a player in developing new technologies and become an ICT hub and a more desirable destination for global companies in research and development, only if there is significantly higher Diaspora participation. Within the context of the global megatrend of increasing geopolitical and economic fractionation and rapid changes in technology, while presenting significant challenges, they also bring forth new opportunities for growth. For the Diaspora to engage more deeply in helping turn Armenia into a global high technology hub in the coming decades, the administration needs to expand on reform momentum to make good use of its potential in the uncertain global economic environment. Under the circumstances of significant internal and external changes, the country has undeniably demonstrated resilience and strong economic recovery through sound macroeconomic management and continued attention to the ICT sector.

However, Armenia will still need to address critical bureaucratic, legal and practical bottlenecks to create more jobs, especially skilled and higher-quality jobs for sustainable development and resistance to economic or geopolitical shocks. One key avenue is strengthening its relationships with the world, especially the non-former-Soviet world. In addition, and to a greater extent through closer communication and cooperation with Diasporan experts and investors, new trade partners and high-tech

products, to leverage its diaspora network. Another area where the Diaspora can play a beneficial part is in enhancing the educational system. There are thousands of high-level educators and administrators in the Diaspora who can greatly benefit the revamping of higher educational institutions, infrastructure development, intellectual property management, innovation in advanced scientific research and development and even in raising education to a global level.

Moreover, firms in Armenia need to branch out to activities that are catalyzed by emerging technologies in which also diasporan experts can play a part. Armenia has the potential and resources to become a network nation through a larger share of and an important role for its diaspora to boost human capital, investment, and connectivity with the high-tech world. With an estimated over 7 million Armenians in the diaspora located in more than 100 countries, the strong links of some of them with Armenia, as well as technical connections of prominent Armenians in various ICT hubs around the globe can play a pivotal role in the accelerated development of the ICT and other sectors, by bringing in technological multinational companies to Armenia, setting up local research and development centers, investing in ICT educational and infrastructure programs, generating leads for local companies, and help create links with knowledge and funding sources, also very important. They can enhance connectivity by promoting trade and Foreign Direct Investment, creating businesses, spurring entrepreneurship, and transferring new knowledge and skills. There is also a vast untapped potential in the value the diaspora can bring to the science and research ecosystem in Armenia. The scientific community of the diaspora excels in quality and performance on a global level. It remains to set up a system or a methodology to be able to tap into that highly important and useful resource.

Ways of Engagement

The strongest ways to engage the diaspora in higher value-added activities include stocktaking of strategic connections in priority sectors and building mechanisms for joint projects. According to an International Organization for Migration report, “the burden rests upon Armenia in stimulating a productive diaspora-country relationship”. However, no matter what specific initiatives and/or policies are developed and implemented by Armenia, there is an essential gap between the major diasporas in

various countries and that of Armenia. This gap can be broken down to operational culture, variations in professionalism, mutual and comprehensive trust, and know-it-all attitude.

For a productive, practical, workable and effective outcome, there should be business, economic, or R&D enticement/attraction related to specific ventures/initiatives that either the government of Armenia would like to implement or is conceptualized/ formulated by professional/academic diasporans. Enticement/attraction toward the diaspora capacity building capabilities, organizational and community engagements related to homeland humanitarian and developmental necessities, as well as major and high priority tasks.

The Armenian Diaspora is composed of complex multiphase, multicenter, multiculture, multi mentality entities, which have diverse levels of “Armenian-ness”, capabilities, attitudes towards the homeland, and the list goes on and on. To be able to engage, in a practical way, all these numerous “entities” in a productive and effective manner is probably highly utopic. However, there are more pragmatic and even essentially altruistic approaches that sometimes are more effective than any policy and/or programmatic methods. Hence, if Armenia is serious in efficiently utilizing Diaspora expertise and capacity building capabilities, they need to develop the right environment for mutual respect, as well as two-way trust and understanding, without compromising the national interests and the fundamental principles of nation building.

There are numerous examples where effective cooperation and farsighted initiatives, which are either initiated by diasporans and carried out by the government, or vice versa. There are even more examples of individual initiatives, which are both planned, designed and implemented by diasporans, although there always needs to be government cooperation, and some kind of participation for a thorough and practically effective results. In any case, there needs to be a complete re-evaluation of methodologies, approaches, policies, and efficient and effective planning for highly beneficial, even mutually beneficial, improvement of cooperation and co-participation. The key policy is to keep away from contrasting social, economic and practically infeasible policies. Rather, there needs to be a well-planned, fine-tuned approach with more transparent communication and transactions with each of the diverse Armenian

communities around the world. In addition, we are living in a professional and digitized world, where time is of the essence. What should be done is first and foremost, evaluate the existing potential of every diasporan community through thorough research about the capacity, capabilities, and practical experiences available in every community. Then, accordingly present specific projects and/or programs to the right audience, with the right incentives and/or promise for the appropriate outcome/benefits and pursue each goal/project with the right attitude/negotiation transparency.

Here are ways that the Diaspora can participate:

1. Investment: Encouraging diasporan experts and financially capable people to invest in the Information and communications technologies (ICT) of Armenian companies and startups, both financially and through mentorship.

2. Knowledge Transfer: Facilitating helping in the transfer of knowledge and skills from diaspora to local ICT professionals in Armenia.

3. Networking: Establishing and strengthening professional networks between diaspora and local ICT professionals in Armenia.

4. Advocacy: Encouraging diasporan experts and organizations to advocate for policies that support the growth of the ICT sector in Armenia, both locally and internationally.

5. Collaboration: Promoting collaboration between diaspora members and local ICT companies and institutions on research, development, and innovation projects.

6. Education: Supporting educational initiatives in Armenia, particularly in the field of ICT, through scholarships, curriculum development, and professional development programs.

7. Entrepreneurship: Encouraging and supporting diaspora members to start ICT businesses in Armenia, or to partner with local businesses on joint ventures.

8. Policy Influence: Engaging with Armenian policymakers to advocate for policies that support the growth of the ICT sector, such as tax incentives, streamlined business processes, and intellectual property protection.

Motivating Diaspora Experts

Motivating diasporan experts to contribute to the scientific and technological development of Armenia may involve several strategies:

1. Building Strong Networks: Establish formal networks and platforms for diaspora experts to connect with local scientists, institutions, and industries. These can be virtual or in-person forums, conferences, and workshops. Which entails unifying all the experts of the same field to be able to effectively interface with them.

2. Incentives and Recognition: Offer incentives such as grants, awards, and recognition programs. acknowledging their contributions.

3. Participating in collaborative Projects: Facilitate joint and impactful research projects, technology transfer initiatives, and innovation collaborations between diaspora experts and local researchers or companies.

4. Clear Communication of Impact: Identify the impact of all projects and clearly articulate how their contributions directly impact the development of Armenia. Sharing success stories and tangible outcomes can inspire further participation.

5. Government Support: Ensure strong governmental backing, through helping create the legal framework and streamlined processes for collaboration, tax incentives, and supportive policies.

6. Professional Development: Provide opportunities for professional growth, through support for access to advanced research facilities, resources, and professional networks.

7. Patriotic Appeal: Leverage a sense of national pride and identity for each critical project. Emphasize the importance of diaspora contributions to the progress and well-being of the people in the homeland.

8. Partnerships with Diaspora Organizations: Diasporans should closely with organizations and influential community leaders to promote involvement and facilitate connections.

9. Digital Platforms: Organizations should be creating and maintaining a robust digital platform for collaboration, knowledge exchange, and project management to overcome geographical barriers.

10. Long-Term Engagement: Establish long-term engagement plans with clear goals and milestones to sustain interest and commitment over time.

The ARPA Institute Experience

The ARPA Institute has been actively involved in various projects and initiatives in Armenia since its founding in 1992. Being a non-profit 501 (3) C organization composed of volunteer experts in various fields, ARPA has achieved success in enhancing existing capabilities and potential through Analysis, Research and Planning for Armenia, and has been able to implement projects that our members believe has had or will have significant impact on education, research, technology or the economy of Armenia. The ARPA Board has always worked and cooperated closely with several ministries and institutions during the implementation of the programs/projects at hand. There have always been hurdles to overcome, i's to dot and t's to cross. Moreover, anyone with experience working in Armenia, especially with the government (as working with any government) in developing and/or implementing project has had to go through a great deal of frustrations, aggravations and disappointments. Anyone who has should know how much patience and conviction is necessary to complete a project and/or implement it in a manner in-line with the plan.

Biographies

David Akopyan worked 26 years for the UN in 15 countries across all regions. Last 10 years of his UN career in Afghanistan, Somalia, and Syria, holding leadership positions as UN Development Program deputy director, country director and Resident Representative.

Arsen Arakelyan, Ph.D., D.Sc., is the director of the Institute of Molecular Biology (IMB), and the director of the Institute of Biomedicine and Pharmacy of the Russian Armenian University (RAU). He has 25+ years of experience in experimental molecular biology/genetics and bioinformatics. He was the first to establish the research direction of genome bioinformatics in Armenia in 2011. Currently, he coordinates several large genomics projects in Armenia. He also teaches courses at RAU.

Hayg Astourian is a seasoned software and security engineering leader with over a decade of experience in hyper-growth environments. As Vice President of Engineering at TUMO, Hayg spearheaded the scaling, modernization, and expansion of TUMO's software to support key initiatives, such as TUMO's rapid growth in Armenia and internationally. His expertise lies in cybersecurity engineering, with a track record that includes co-founding the Security team at Cisco Meraki and leading the Platform Security team at Stripe. Over the past few years, while living in Armenia, Hayg has been engaged in cultivating Armenia's cybersecurity ecosystem, delivering talks, providing training, and organizing TUMO's emerging cybersecurity program

Berge Ayvazian is a senior ICT industry analyst and consultant, with a 40-year career. including more than 20 years with Yankee Group and 5 years with Light/Heavy Reading. He joined Wireless 20/20 in 2009, following more than 20 years as CEO, senior telecom industry analyst and strategy consultant with Yankee Group, which he sold to Reuters 1999. Ayvazian later served as strategy director for the Reuters Research and Advisory Unit.

Berge is currently a Partner, Senior Analyst and Consultant with Wireless 20/20, an independent market research and consulting company focused on the rapidly evolving wireless, fiber and mobile broadband markets. Berge currently works with Wireless 20/20 to demonstrate how operators can leverage the WiROI™ db Geospatial SaaS Platform to select the best locations to deploy fiber and wireless broadband networks, compete for BEAD grants and support investors making Broadband Infrastructure investment decisions. Wireless 20/20 has a team of software developers and GIS Data Analysts based in Armenia.

Wireless 20/20 has developed a suite of WiROI™ Business Case tools for Wireless 5G and IoT networks to help develop clients develop their wireless technology roadmaps and WiROI™ Business Case to optimize their 5G network deployments. Ayvazian leads an integrated practice to help mobile operators and their vendors to develop their wireless technology roadmaps and build a complete WiROI™ 5G and IoT Business Case. He is currently conducting research on how the wireless industry can harness AI and machine learning in the climb to 5G networks. Ayvazian is a frequent speaker at ICT industry events, including NetworkX and Broadband Nation Expo. He was co-chairman of 4G World Conference and Expos in the US and India, Tower & Small Cell Summit and Mobile Internet World conference programs.

Ayvazian has also been active in the tech startup and venture capital industries for more than 30 years as an advisor to Battery Ventures and Grotech Ventures. Berge has also been active in the Armenian tech market since 2000 and was co-founder of the Armenian High Tech Council (ArmTech) with other diasporan Armenians helping to drive the growth and increase employment in the Armenian high technology sector. In addition, he has been active in the Angel Investor Club of Armenia (AICA), serves as a Board Member of EQWEFY and is Managing Director of Distrikt Ventures.

Berge has participated in the faculty of the Sevan Startup Summit, and has helped organize and moderate keynote panels during WCIT, DigiWeek and Digitec Summits in Armenia from 2018-24. Berge Ayvazian recently gave a Keynote presentation at the FemInno24 conference on Driving AI Startup Growth - Beyond Limits Within Ethics. In a

recent interview, Ayvazian noted that Armenia is on the path to becoming a global leader in artificial intelligence and has been growing AI companies for more than ten years.

Ayvazian has an MA in Telecom Policy Research at Annenberg School of Communications at the University of Pennsylvania, and is a former member of the adjunct faculty at Boston University's College of Communication· Former member of the adjunct faculty at Boston University's College of Communication.

Arpie G. Balian is an educator and experienced professional with doctoral degrees in Leadership and in Performance Monitoring and Evaluation. She has over thirty years' experience in teaching university undergraduate and graduate courses in public policy, monitoring and evaluation, civil service reform, and related topics of public sector governance. She has authored dozens of white papers for the U.S. Government on topics related to employee performance, recruitment and retention, and has published dozens of research papers dealing with topics of populism and democracy; migration, civil society; state building and development challenges. She has delivered papers at international conferences in Europe, Asia, and the Middle East on topics related to evaluation, government performance, and the science of developing measurements and tracking performance for institutional progress and country development. She is the recipient of multiple awards from the U.S. government, the provincial government of Armavir in Armenia, and other international organizations.

Anzhela Baltayan, Ph.D. in Organic Chemistry, Associate Professor.

She is a lecturer at the Gyumri branch of the National Polytechnic University of Armenia (NPUA). Dr. Baltayan is also an international expert for the Organization for the Prohibition of Chemical Weapons (OPCW). Within the framework of this international organization's programs,

she regularly conducts training for representatives from military and scientific sectors worldwide.

She serves as the Head of the Training and Methodological Support Department at the Shirak Regional Pedagogical-Psychological Support Center and as a mentor for the Republican Pedagogical-Psychological Center. In these roles, she trains specialists from schools in the Shirak region on the latest teaching methods and approaches, promoting the implementation of inclusive education.

She is the co-founder of the "Contests Lab" educational NGO, where she organizes various team and individual competitions to motivate students' learning and enhance their capacity to learn through play.

Dr. Baltayan is the Executive Director of the "Gyumri Development Laboratory" (GDL), an educational foundation that provides alternative STEAM education opportunities in the Shirak region. Under her leadership, GDL offers students the chance to develop skills in robotics, science subjects, logic, art, speech, graphic design, and languages. The education at GDL is distinguished by its innovative teaching methods and approaches, helping all students reach their full potential by learning to learn through dreaming big, playing, creating, and applying knowledge.

Vasiliy Burov is a researcher focused on digital transformation of the economy and entrepreneur.

Hriar Cabayan is currently a Visiting Scientist at the Lawrence Livermore Laboratory. He joined the Laboratory in 1977. In 1997 he joined the Joint Staff (Pentagon) where he managed a program to support operational planning. He received the Joint Meritorious Civilian Service Award from

the Office of the Chairman, Joint Chiefs of Staff in 2007 and again in 2019. He returned to Lawrence Livermore Laboratory in October 2019. He received his Doctorate Degree from the University of Illinois in Urbana, Illinois. After graduating, he taught mathematical physics for four years at New York University's Courent Institute of Mathematical Sciences and McGill University before joining Lawrence Livermore laboratory.

Armen Danielian is an energy analyst with a focus on the regulatory and economic aspects of energy systems. He holds a BBA from Business School Lausanne and an MSc in Energy Systems from the University of Oxford. Following his education, he worked with the United Nations Industrial Development Organization in the areas of electric mobility and climate change adaptation, as well as co-authored Armenia's Energy Independence Roadmap report He is currently an Adjunct Lecturer in Sustainable Energy at the American University of Armenia, and a researcher at the Acopian Center for the Environment.

Armen Der Kiureghian is Taisei Professor of Civil Engineering Emeritus at the University of California Berkeley, and co-founder and President Emeritus of the American University of Armenia. He is an elected foreign member of the National Academy of Sciences of Armenia and an elected member of the U.S. National Academy of Engineering.

Scott Fisher, Ph.D., is an Assistant Professor in the Security Studies Department at New Jersey City University (NJCU). Prior to his PhD studies at Rutgers University, he received an MA in Security Studies from Georgetown University and an MA in Korean and International Studies from Seoul National University in South Korea. His research focus is information warfare, U.S. security challenges in Asia, and open-source intelligence. His research has been published by organizations including Foreign Policy

Analysis, RAND, Demokratizatsiya, the Journal of Information Warfare, and West Point's Modern War Institute. He has presented at conferences for organizations including the International Studies Association, the American Political Science Association, the Midwest Political Science Association, NATO, and other professional and academic organizations. In addition to his work at NJCU, Dr. Fisher has worked for the U.S. Department of Defense at the Pentagon, as well as in Iraq, Afghanistan, East Africa, and Germany.

Lev Freinkman is a development economist, currently working as a consultant for the World Bank. Used to serve a World Bank country economist for Armenia 25 years ago.

Robert Ghazaryan, PhD, Associate Professor

Education

2001-2005 - Institute of History, NAS RA, postgraduate student

1995-2001 - Armenian State Pedagogical University named after. Khachatur Abovyan, Faculty of History and Geography

Working experience

From 2005 to the present - Institute of Oriental Studies NAS RA, Leading researcher

2008-2013 - Scientific Secretary of the Institute of Oriental Studies NAS RA

2013-2020 - Deputy Director of the Institute of Oriental Studies NAS RA

2020-2023 - Director of the Institute of Oriental Studies NAS RA

December 2023 to present - Director of the "Geghard" Scientific and Analytical Foundation

From 2008 to the present - Head of the Department of Oriental Studies at the International Scientific and Educational Center of the National Academy of Sciences of the Republic of Armenia

2020-2023 - Editor-in-chief of the journal Bulletin of the Institute of Oriental Studies

From 2014 to present - Member of the editorial board of the electronic journal “Fundamental Armenology”

2021-2023 - Chairman of the specialized council “World History” at the Institute of Oriental Studies of the NAS RA

From 2014 to the present - Associate Professor of the Department of World History and its teaching methods, Faculty of History and Social Sciences, Khachatur Abovyan Armenian State Pedagogical University

From 2020 to the present - Associate Professor of the Department of World History, Faculty of History, Yerevan State University

2009-2021 - Teacher of Armenian history at the school of the Mekhitarist congregation in Yerevan

Retraining, Conferences, Discussions

March 28-30, 2024 - International conference “Armenia as a crossroads of civilizations”, Yerevan, Armenia.

September 26-27, 2023 - One Belt, One Road Initiative, International Forum, Beijing, China.

September 27-29, 2019 - Historical and cultural heritage of Shirak: modern issues of Armenian studies, Gyumri, Armenia

October 17-19, 2013 - Second International Conference on Armenian Studies “Armenian Studies and Modern Challenges”, Yerevan, Armenia.

Author of about 40 scientific articles.

Adam A. Kablanian

Adam is a High Technology CEO, serial entrepreneur, and investor.

Adam is the General Partner of S-unik venture fund focused

on investing in private defense and security companies in Armenia. Before S-unik, Adam was CEO at Germany-based Cynora GmbH, a company innovating advanced OLED (Organic Light Emitting Diode) materials.
He is the founding board chairman and a lead investor of Paradromics (https://paradromics.com), a startup company developing next-generation neural interface technology.

Prior to his role at Paradromics, Adam was the Chief Executive Officer of Memoir Systems, a venture-backed memory IP company. Cisco successfully acquired Memoir Systems in October 2014. Adam also, co-founded and served as the Chief Executive Officer of iCON Communications. iCON Communications is a premier broadband Internet Service Provider (ISP) in Armenia, utilizing state-of-the-art WiMAX technology.
He also served as the Chairman of the Board (until March 2008) and Chief Executive Officer (until March 2007) of Virage Logic. He co-founded this company in 1996 and subsequently took it public on NASDAQ (VIRL.) in August 2000.

Nerses Kopalyan is an associate professor-in- residence of Political Science at the University of Nevada, Las Vegas. His fields of specialization include international security, geopolitics, political theory, and philosophy of science. He has conducted extensive research on polarity, superpower relations, and security studies. He is the author of World Political Systems After Polarity (Routledge, 2017), the co-author of Sex, Power, And Politics (Palgrave Macmillan, 2016), co-author of Latinos in Nevada: A Political, Social, and Economic Profile (Nevada University Press, 2021), and co-author of Armenia, Azerbaijan, and the 2020 Nagorno-Karabakh War (Taylor and Francis, forthcoming 2023). He is also a regular contributor to EVN Report with over 50 articles. He has also contributed publications with Le Figaro, The Times of Israel, and The National Interest. His current research and academic publication concentrate on geopolitical and great power relations within Eurasia, its impact on small state security, and the broader implications for democratic breakthroughs within authoritarian orbits. He has conducted extensive field work in Armenia on the country's security architecture and its democratization process. He has

authored several policy papers for the Government of Armenia and served as voluntary advisor to various state institutions.

Haykuhi Muradyan PHD in Cultural Studies
Her research interests focus on cultural anthropology, applied anthropology, anthropology of politics and heritage management. She is lecturing in the department of Cultural Studies, YSU. She teaches the courses Theory of Cultural Studies, Cultural policy, and Armenian culture of the Modern period. She also teaches a course on theories of Cultural Genocide at the Department of Genocide Studies at the Institute of Armenian Studies, YSU.

Hagop Panossian was a Technical Fellow at Boeing (now retired) and has over 30 years of experience in control & modeling of rocket engines, large space structures and actuation systems, failure detection, stochastic systems, vibration damping and optimal and adaptive control and has patents. Panossian was selected as a Fulbright Exchange Scientist in 1987 and spent one semester in Armenia. Hagop has published 82 articles in the fields of control systems, modeling and control of dynamic systems, vibration suppression, and failure detection in numerous technical journals and conference proceedings. He is also the co-author of two books published by Academic Press. He is the inventor of “Non-Obstructive Particle Damping” (NOPD), a novel passive vibration damping technique, as well as several failure detection techniques. He has designed the control system for the SRS 2200, the Aerospike engine (X33), the most advanced rocket engine ever built and tested, and has worked on the Space Shuttle Main Engine, the National Aerospace Plane, the International Space Station and in other NASA and Air Force programs. Hagop is the recipient of the prestigious Engineer of the Year, as well as the President's awards from Rocketdyne. Dr. Panossian has founded two professional and charitable organizations in Los Angeles, the Armenian Engineers & Scientists of America (1983)

and the ARPA Institute (1992). He has served as president of the former for two years and has served as president of the latter since its founding. During his presidency, he organized the World Congress, held in 1989, chaired by Dr Mihran Agbabian. As president of ARPA, he has worked extensively with the Government of Armenia, as a member of the Economic & Industrial Advisory Board, as well as with various Ministries of the republic of Armenia. He continues to work with the current Government of Armenia through various Ministries, the universities and the academy of sciences. He organizes conferences and seminars directed towards the enhancement of education, science technology, healthcare, and other areas that are related to Armenia and Armenians. Dr. Panossian is a graduate of the Armenian Evangelical School of Anjar, Lebanon, has received his B.S. in Mathematics from the American University of Beirut, his M.S. in applied mathematics from the University of South Carolina, Columbia, and his Ph.D. from the University of California in Los Angeles in Control Systems Engineering.

Artak Sahakyan has PhD in economics, delivers lectures in Public Administration Academy and having more than 22 years of work experience in financial sector.

Artak is a tech blogger that makes posts and writes articles about tech sector of Armenia in his social media channels (t.me/armtechblog, www.linkedin.com/in/artakng, etc.)

Artak is an active networker, connecting people and ideas.