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COMPONENTS OF THE FUTURE UKRAINIAN ARMAMENTS ECOSYSTEM

In a previous publication, the authors outlined the strategic requirements for the concept of Ukraine's weapons ecosystem, including its vision, mission, the conceptual role of the architect, aspects of strategic planning and potential implementation strategies. It was demonstrated that the architecture of Ukraine's weapons system should comply with these requirements in a general methodological sense.

This article further details the key components of the future weapons ecosystem, focusing on its primary elements, the critical roles and the values they generate.

Keywords: principles for forming elements of Ukraine's weapons ecosystem, main elements of Ukraine's weapons ecosystem, stakeholders responsible for the development and supply of weapons to the armed forces.

INTRODUCTION

As noted in [1, 2], many developed countries have long observed a trend toward forming defense industry ecosystems in their national defense and security sectors. However, this trend has gained particular intensity with the outbreak of full-scale war in Europe. Publications [1, 3] presented the strategic requirements for Ukraine's weapons ecosystem, including its vision, mission, the conceptual role of the architect, aspects of strategic planning and potential implementation strategies. The authors argued that the architecture of Ukraine's weapons system must adhere to these requirements in a broad methodological sense.

However, due to space limitations in these publications, the detailed structure of the future weapons ecosystem was not addressed.

The purpose of this article is to outline the primary elements of the weapons ecosystem and the key values they create. In the authors' view, this approach to forming Ukraine's weapons ecosystem will strengthen the country's defense capabilities, reduce external dependence, stimulate technological progress and foster the development of a self-sufficient defense industry. This aligns with national security priorities and positions Ukraine as a capable and reliable defense partner on the global stage.

RESEARCH RESULTS

To discuss the formation of the elements of Ukraine's weapons ecosystem, we consider several key aspects characteristic of the structures involved in and responsible for developing and supplying weapons to the armed forces.

These aspects include (Fig. 1): Technological progress; National security; Ethical foundation; Collaboration and partnerships; Adaptability and flexibility; Cost-effectiveness and efficiency; Sustainability and environmental responsibility [4–7].

By adhering to these principles, Ukraine's organizational weapons system can ensure that the armed forces have access to the most advanced and effective weapons. At the same time, it upholds ethical standards, promotes national security and fosters cooperative relationships with various stakeholders.

Technological Progress: The defense system should strive to be at the forefront of technological innovation, investing in research and development to create cutting-edge, advanced weapon systems.

National Security: Prioritization of capabilities that align with the country's defense strategy and support long-term security interests.

Ethical Foundation: The defense system must operate within clear ethical boundaries, ensuring the responsible use of weapons. This includes designing weapons that are precise, discernible and proportional in their application.

Collaboration and Partnership: The system should foster collaboration with various stakeholders, including the armed forces, research institutions, industry experts and allied nations to enhance defense system efficiency.

Adaptability and Flexibility: Continuous monitoring of emerging technologies, understanding new trends in warfare and adapting to the changing needs of the armed forces.

Cost-Effectiveness and Efficiency: Resource optimization, streamlined procurement procedures and leveraging economies of scale where possible to ensure the best value for the armed forces.

Sustainability and Environmental Responsibility: Considering the environmental impact of weapon development and striving to minimize any negative effects.

By adhering to these principles, the defense system can provide the armed forces with access to the most modern and effective weapons while upholding ethical standards, promoting national security and fostering collaborative relationships with diverse stakeholders.

Ministry of Defense: The government or Ministry of Defense provides overall strategic direction and political

Technological progress	National security	Ethical foundation	Collaboration and partnerships	Adaptability and flexibility	Cost-effectiveness and efficiency	Sustainability and environmental responsibility
The defense system should strive to be at the forefront of technological innovation, constantly pushing the boundaries of what is possible in terms of weapon development. This includes investing in research and development to create advanced, state-of-the-art weapons systems that provide a decisive advantage to the armed forces.	The main goal of the defense system should be to strengthen national security. This means ensuring that the armed forces have access to reliable, effective, and versatile weapons that can withstand a wide range of threats and challenges. The priority should be to develop capabilities that are consistent with the country's defense strategy and support its long-term security interests.	The defense system should operate within a clear ethical framework that ensures the responsible use of weapons. This includes compliance with international laws and conventions governing the conduct of war, as well as considerations of human rights, the protection of civilians, and minimizing collateral damage. The vision should emphasize the development of weapons that are accurate, discriminating and proportionate in their use.	The defense system should promote collaboration and partnership with various stakeholders, including armed forces, research institutions, industry experts, and allied nations. Such cooperation can lead to shared knowledge, joint development projects, and resource optimization, ultimately enhancing the efficiency of the defense system.	The defense system must be adaptive and flexible, able to respond to new threats and changes in the geopolitical landscape. This requires continuous monitoring of new technologies, understanding new trends in warfare, and responding to the needs of the armed forces. The vision should emphasize the development of modular and upgradeable weapon systems to meet future advances and operational requirements.	The defense system should strive for cost-effective processes in the development and supply of weapons. This includes optimizing resource allocation, streamlining procurement procedures, and leveraging economies of scale where feasible. The vision should emphasize the necessity of delivering high-quality weaponry within budget constraints, ensuring the best value for money for the armed forces.	The defense system should take into account the impact of weapons development on the external environment and to minimize any negative consequences. This includes implementing sustainable practices. The vision should emphasize the importance of responsible use of resources and minimizing the environmental footprint of weapons systems.

Fig. 1. Key Aspects of the Weapons Ecosystem

Ministry of Defense	The government or Ministry of Defense provides overall strategic direction and political leadership for the defense system. It formulates defense priorities, allocates budgets, and ensures coordination with other defense agencies.
Defense Research and Development Organizations	Responsible for research, design, and development of weapons and defense technologies. These organizations conduct scientific research, create prototypes of new systems, and collaborate with industry and academia to enhance weapon capabilities.
Research Institute of Weapons	The research institute conducts scientific activities aimed at improving weapons systems, technologies and military equipment. It is aimed at increasing the productivity of capabilities and effectiveness of weapons supplied to the armed forces
Defense Industry	Comprising state-owned and private companies, the defense industry is involved in the development, production, and supply of weapons and defense equipment
Procurement and Acquisition Agencies	Manage the procurement process for weapons and defense equipment, including contract negotiations, quality assurance, and logistics.
Testing and Evaluation Units	Specialized organizations responsible for assessing the performance, reliability, and safety of weapons and equipment
Armed Forces	Provide requirements and operational data for the development, testing, and evaluation of weapons. The armed forces work closely with the defense industry and procurement agencies to ensure the weaponry meets their specific needs.
Standards and Regulatory Bodies	Develop and implement standards, regulations, and safety protocols related to the design, production, and use of weapons.
International Cooperation	Foster collaboration with allied nations, participate in joint development projects, and exchange research and intelligence information.

Fig. 2. Main Elements of the Weapons Ecosystem

leadership for the defense system. It formulates defense priorities, allocates budgets and ensures coordination with other defense agencies.

Defense Research and Development Organizations: Responsible for research, design and development of weapons and defense technologies. These organizations conduct scientific research, create prototypes of new systems and collaborate with industry and academia to enhance weapon capabilities.

Defense Industry: Comprising state-owned and private companies, the defense industry is involved in the development, production and supply of weapons and defense equipment.

Procurement and Acquisition Agencies: Manage the procurement process for weapons and defense equipment, including contract negotiations, quality assurance and logistics.

Testing and Evaluation Units: Specialized organizations responsible for assessing the performance, reliability and safety of weapons and equipment.

Armed Forces: Provide requirements and operational data for the development, testing and evaluation of weapons. The armed forces work closely with the defense industry and procurement agencies to ensure the weaponry meets their specific needs.

Standards and Regulatory Bodies: Develop and implement standards, regulations and safety protocols related to the design, production and use of weapons.

International Cooperation: Foster collaboration with allied nations, participate in joint development projects and exchange research and intelligence information.

Each element of the ecosystem plays a critical role and contributes unique values.

For example, the Ministry of Defense, as the central authority, is responsible for formulating and implementing the strategic direction and ensuring the defense system's

alignment with national security goals [11–13]. The coordination among these elements ensures the defense system's resilience, efficiency and ability to meet the armed forces' needs effectively (Fig. 3).

Oversight and Accountability: The Government/Ministry of Defense oversees the activities of various components, including research organizations, procurement agencies and the defense industry, ensuring compliance with regulations, policies and ethical standards.

Strategic Planning and Policy Formulation: It is responsible for formulating strategic defense policies aligned with national security goals. This includes assessing the country's defense needs, identifying potential threats and establishing long-term defense plans.

Resource Allocation and Budgeting: The Government/Ministry of Defense allocates financial, human and technological resources to support the defense system.

International Cooperation and Diplomacy: Engages in diplomatic efforts to foster partnerships with other countries, share defense-related knowledge and promote joint development and procurement projects.

Ensuring National Security: Guarantees that the armed forces have the necessary capabilities to protect the country's sovereignty, territorial integrity and citizen safety.

Stakeholder Coordination: Facilitates collaboration and coordination among stakeholders in the defense system, including the armed forces, defense industry, research institutions and other relevant organizations.

Crisis Management and Decision-Making: Plays a critical role in crisis resolution and decision-making, providing leadership, strategic guidance and support to address emerging threats and challenges.

The Government/Ministry of Defense delivers value by providing strategic leadership, resource distribution,

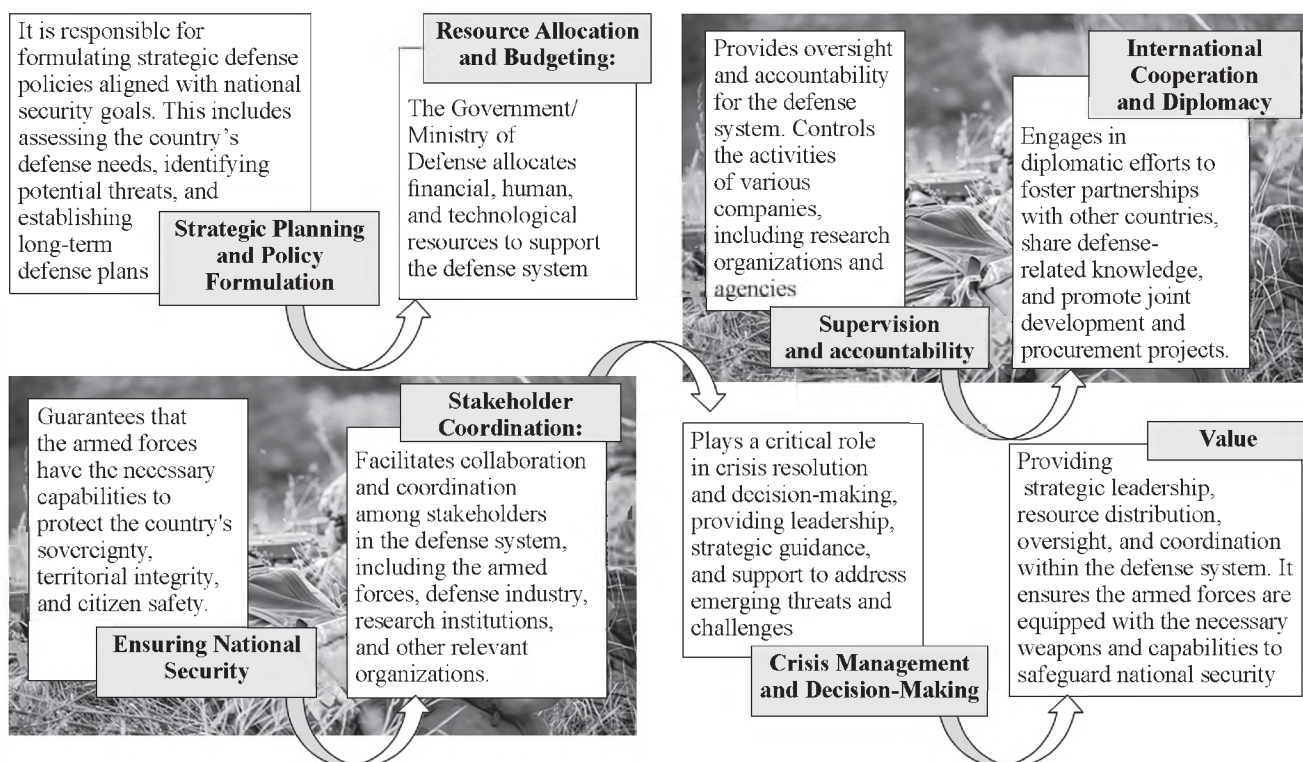


Fig. 3. Key Roles and Values Created by the Government/Ministry of Defense of Ukraine

oversight and coordination within the defense system. It ensures the armed forces are equipped with the necessary weapons and capabilities to safeguard national security, contributing to overall stability and the country's defense readiness. The next key element in the ecosystem is the Defense Research and Development Organization (DRDO), which plays a critical role in the defense system by developing and delivering weapons to the armed forces [14, 15].

Research and Innovation: Conducts scientific research to develop innovative technologies for advanced weapon systems.

Prototyping and Testing: Designs and tests prototypes to ensure new systems meet operational and safety standards.

Collaboration with Industry and Academia: Works closely with the defense industry and academic institutions to enhance technological capabilities.

Technology Transfer: Facilitates the transfer of developed technologies to the defense industry for mass production.

Operational Support: Provides technical expertise and support to the armed forces during the deployment and use of new weapon systems.

The DRDO serves as a cornerstone for fostering technological progress within the defense ecosystem, ensuring the development of cutting-edge systems that strengthen the armed forces' operational effectiveness.

Technological Innovations: DRDO is primarily responsible for the research, design and development of advanced defense technologies and weapon systems. Through scientific and engineering research, as well as experimentation, it

pushes the boundaries of technological innovation in defense. DRDO creates value by developing cutting-edge technologies that provide the armed forces with a strategic advantage and enhance their operational capabilities.

Alignment with Operational Needs: DRDO works closely with the armed forces to understand their operational requirements and challenges. By collaborating with end users, DRDO develops weapon systems tailored to specific operational needs.

Research Nationalism and Self-Reliance: DRDO plays a critical role in advancing domestic defense capabilities and reducing dependence on foreign suppliers. It aims to develop critical technologies and weapon systems within the country, fostering self-reliance in defense production.

Technology Transfer and Collaboration: By partnering with industry, research institutions and academia, DRDO leverages external expertise and resources. This collaborative approach creates value by pooling expertise, minimizing duplication of efforts and accelerating the development of advanced defense technologies.

Testing and Evaluation: DRDO conducts rigorous testing procedures to assess the performance, reliability, safety and effectiveness of its developments. This ensures that the armed forces receive thoroughly vetted and operationally suitable weaponry.

Intellectual Property and Defense Exports: DRDO generates intellectual property (IP) through its research and development efforts. This IP can be licensed or transferred to national defense industry enterprises for commercialization. Additionally, DRDO promotes defense

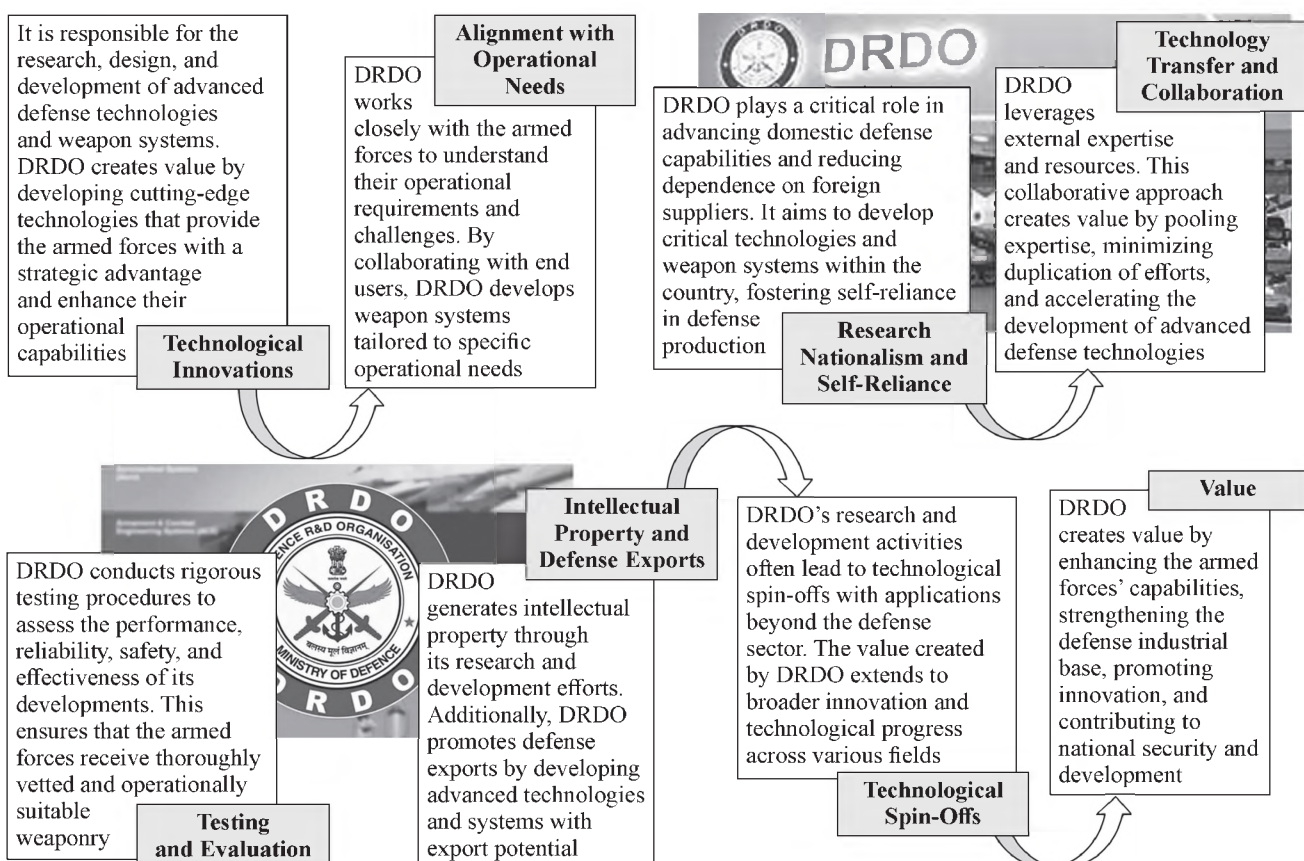


Fig. 4. Key Roles and Values Created by the Defense Research and Development Organization (DRDO)

exports by developing advanced technologies and systems with export potential.

Technological Spin-Offs: DRDO's research and development activities often lead to technological spin-offs with applications beyond the defense sector. The value created by DRDO extends to broader innovation and technological progress across various fields.

Overall, DRDO plays a crucial role in driving technological innovation, aligning with operational needs, fostering self-reliance and enabling collaboration within the defense ecosystem. By developing advanced defense technologies and weapon systems, DRDO creates value by enhancing the armed forces' capabilities, strengthening the defense industrial base, promoting innovation and contributing to national security and development.

In addition to DRDO, the Ministry of Defense should maintain a Weapons Research Institute, working alongside DRDO. The roles and interactions between these entities may vary depending on the country's defense structure [16]. The institute complements DRDO's efforts by conducting specialized research, further enriching the defense ecosystem and contributing to innovation, operational effectiveness, and national security (Fig. 5).

Additional Research: The Weapons Research Institute, operating under the Government/Ministry of Defense, can focus on specific areas of weapon development, complementing the broader research efforts of DRDO.

Collaboration and Synergy: Joint efforts between the Weapons Research Institute and DRDO leverage their respective expertise, facilities and resources. This collaboration fosters synergy, minimizes duplication and accelerates advancements in targeted research domains.

Alignment with Operational Requirements: Under direct control of the Government/Ministry of Defense, the institute

can align its research activities closely with strategic priorities and operational needs set by the ministry.

Rapid Prototyping and Evaluation: The institute can develop prototypes based on emerging technologies or operational concepts, enabling swift evaluation and validation of new systems.

Technological Expertise: The institute should house researchers and scientists with specialized knowledge and experience, providing solutions to complex technical challenges. This expertise adds value by offering unique perspectives and advancing progress in specific areas.

Scientific and Strategic Guidance: As part of the Ministry of Defense, the institute contributes to shaping defense policy and strategic direction. This ensures policy decisions align with technological capabilities and constraints.

Support for the Defense Industrial Base: The institute can foster growth and development of the domestic defense industry by collaborating with manufacturers and suppliers. It facilitates technology transfer and provides technical expertise to aid weapon production and integration into the industrial base.

Although the specific roles and interactions between the Weapons Research Institute and DRDO may vary, their collaboration can yield mutual benefits, including:

- enhanced knowledge sharing;
- optimized resource utilization.

Development of technologically advanced weaponry that aligns with defense priorities set by the Ministry of Defense.

The next core element in the weapons ecosystem is the Defense Industry, which plays a crucial role in the defense system by developing and supplying weapons to the armed forces [10–12]. Fig. 6 shows the key roles and values created by the defense industry.

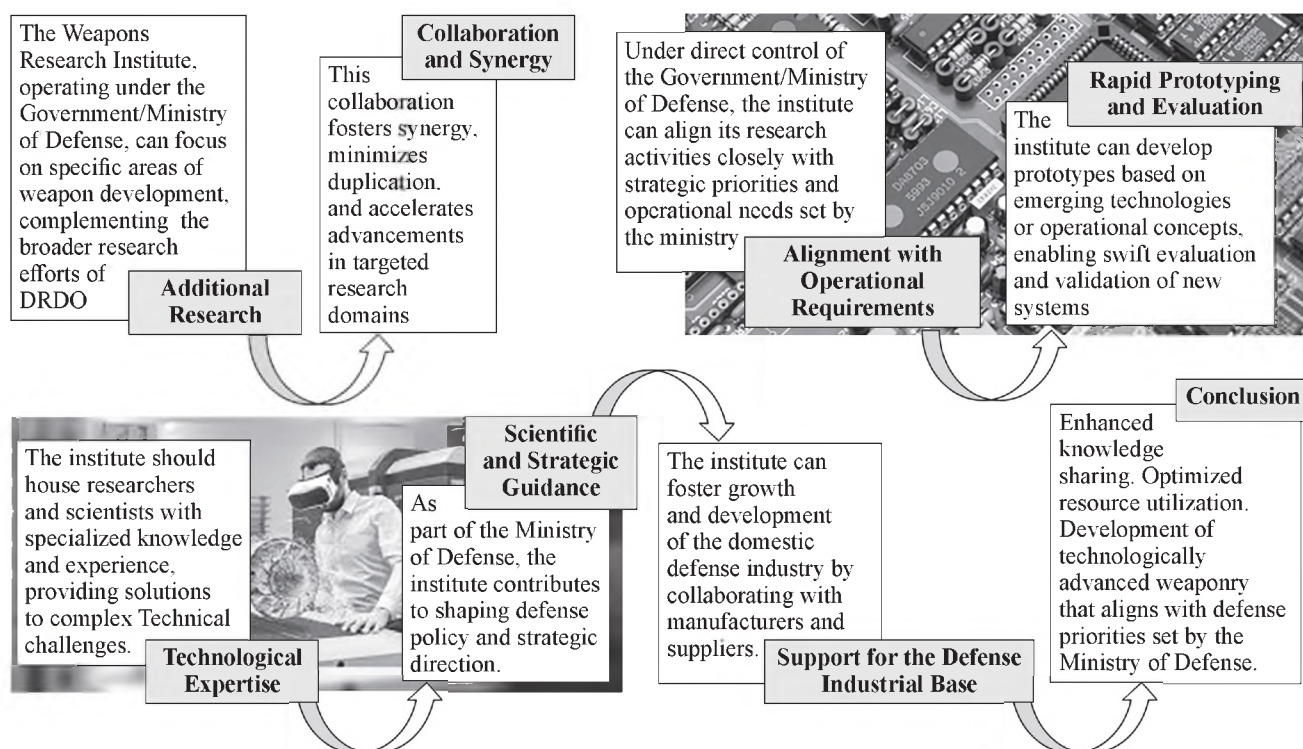


Fig. 5. Key Roles and Values Created by the Weapons Research Institute

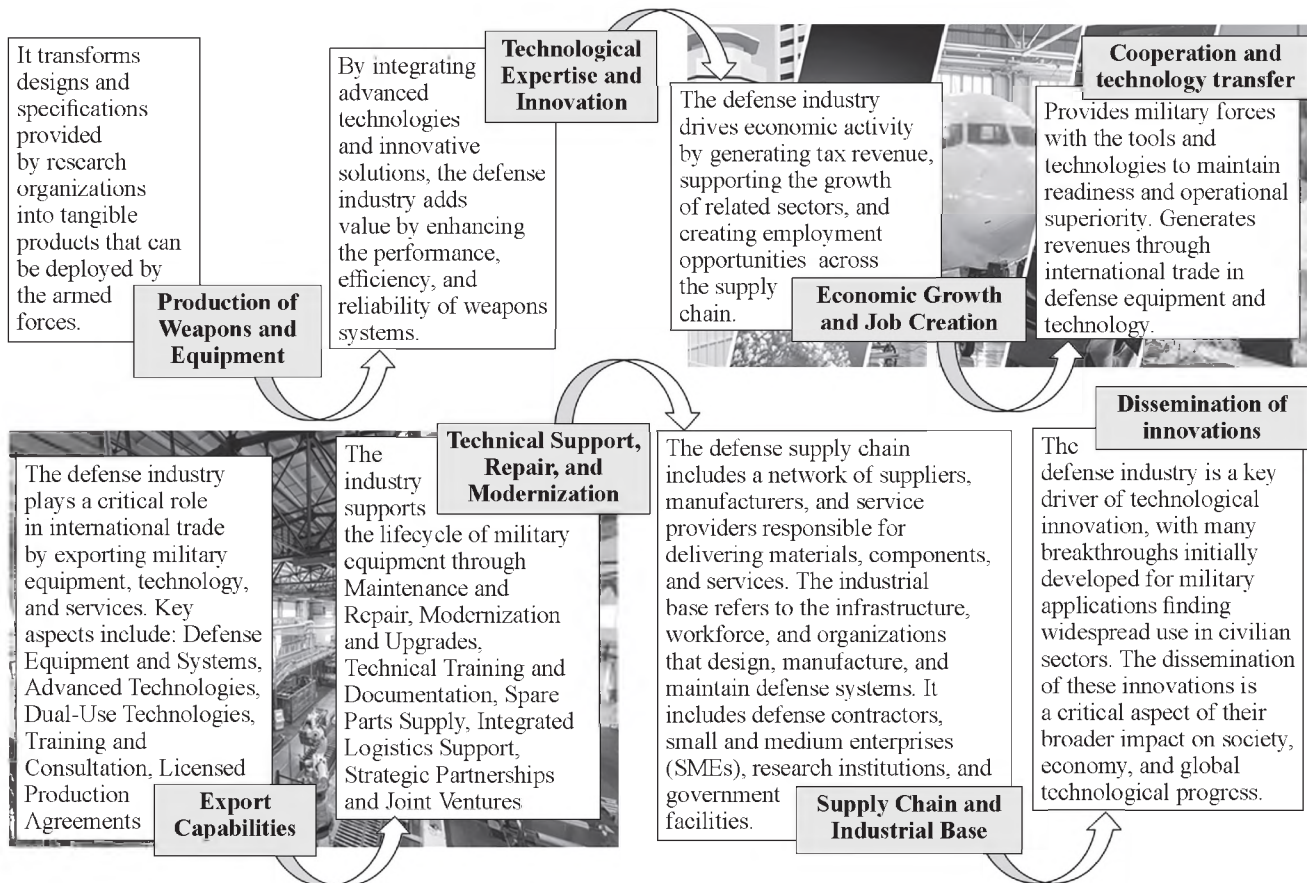


Fig. 6. Key Roles and Values Created by the Defense Industry

Production of Weapons and Equipment: The defense industry is responsible for manufacturing weapons, ammunition and related defense equipment. It transforms designs and specifications provided by research organizations into tangible products that can be deployed by the armed forces.

Technological Expertise and Innovation: By integrating advanced technologies and innovative solutions, the defense industry adds value by enhancing the performance, efficiency and reliability of weapons systems.

Economic Growth and Job Creation: The defense industry drives economic activity by generating tax revenue, supporting the growth of related sectors and creating employment opportunities across the supply chain.

The defense industry contributes significantly to the ecosystem by:

- producing critical defense systems to meet the needs of the armed forces;
- advancing technological progress to ensure cutting-edge capabilities;
- stimulating economic development and fostering innovation;
- supporting operational readiness by providing reliable and efficient weaponry.

Through these roles, the defense industry ensures that the military remains prepared, well-equipped and capable of addressing both current and future security challenges.

The next element is the Supply and Procurement Agencies, which play a crucial role in the defense system and are responsible for the development and supply of

weapons to the armed forces [11, 14]. Fig. 7 shows the key roles and value created by supply and procurement agencies. **Acquisition planning and strategy:** These agencies are responsible for formulating acquisition plans and strategies in coordination with the government and the ministry of defense, conducting market research and developing acquisition strategies that meet overall defense objectives. Value creation ensures effective acquisition processes to meet the needs of the armed forces.

Acquisition process management: Acquisition and procurement agencies manage the entire procurement process, from defining requirements to contracting and delivery. The value creation is to optimize procurement operations, promote transparency and facilitate fair competition between potential suppliers.

Contract Negotiation and Management. Agencies negotiate contracts with suppliers, ensuring favorable terms and conditions. They oversee contract execution, manage risks and resolve disputes that may arise during the contract's lifecycle. Value creation involves ensuring procurement contracts are executed efficiently, within budget and according to specifications.

Cost and Budget Control. Procurement and acquisition agencies are responsible for cost control and ensuring the best value for money. Value creation focuses on optimizing resource allocation, maximizing the availability of weaponry and minimizing expenditures.

Supplier Relationship Management. Agencies strengthen relationships with suppliers and contractors by maintaining open communication channels and fostering

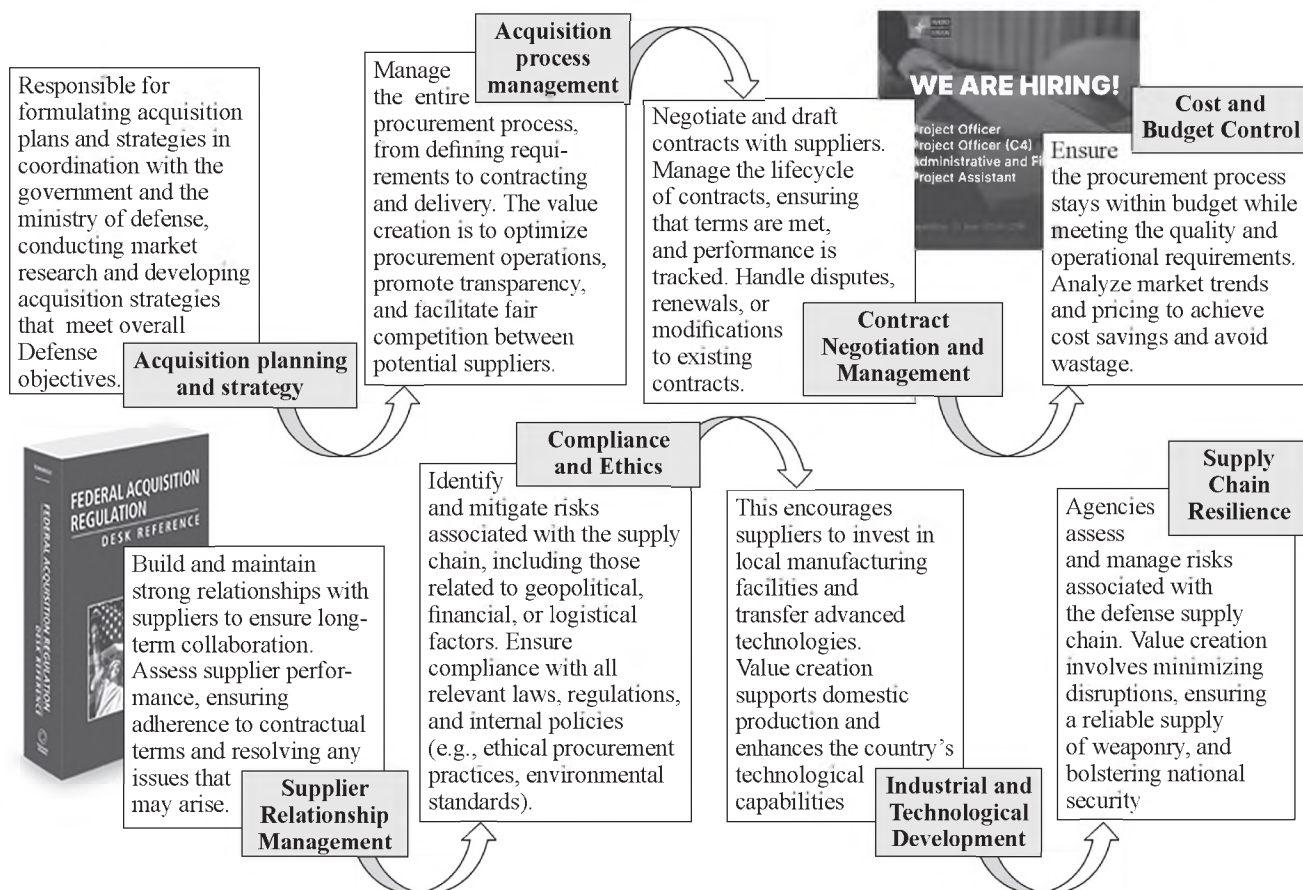


Fig. 7. Key roles and values created by Supply and Acquisition Agencies

collaboration throughout the procurement lifecycle. Value creation promotes a healthy supplier ecosystem, encourages competition and drives innovation in the defense industry.

Compliance and Ethics. Agencies ensure adherence to legal, regulatory and ethical standards in the procurement process. Value creation lies in upholding ethical principles, preventing corruption and maintaining public trust in the defense procurement system.

Industrial and Technological Development. These agencies can stimulate industrial and technological growth in the domestic defense sector by including offset requirements or technology transfer provisions in contracts. This encourages suppliers to invest in local manufacturing facilities and transfer advanced technologies. Value creation supports domestic production and enhances the country's technological capabilities.

Supply Chain Resilience. Procurement and acquisition agencies assess and manage risks associated with the defense supply chain. Value creation involves minimizing disruptions, ensuring a reliable supply of weaponry and bolstering national security.

Overall Value of Procurement and Acquisition Agencies. Procurement and acquisition agencies play a critical role in:

- efficiently managing procurement processes to meet operational needs;
- controlling costs and ensuring the best return on investment;
- developing strong supplier relationships that foster innovation and competition;

- upholding compliance and ethical standards to maintain transparency and accountability;
- promoting industrial and technological growth to strengthen domestic capabilities;
- ensuring a resilient supply chain to support the armed forces effectively.

These contributions ensure that the defense procurement system operates efficiently and supports the overarching goals of national security and military readiness.

The next element, Quality Assurance, responsible for weapons quality assurance, testing, and conformity assessment, plays a crucial role in the armed forces supply ecosystem [3, 16]. Key views on its role and the value it creates are shown in Fig. 8.

Quality assurance: This element is responsible for establishing and implementing quality standards and processes to ensure that the delivered weapons meet the required specifications, performance standards and safety regulations. This involves conducting rigorous testing and evaluation of weapons and related equipment to verify their functionality, reliability and durability.

Conformity and Conformity Assessment: Ensures that the delivered arms comply with applicable national and international regulations, export controls and arms trade agreements. This element conducts conformity assessment, which may include inspections, certification and verification processes to ensure compliance with legal, technical and safety requirements.

Risk Mitigation. Through rigorous testing and compliance evaluation, this component reduces the risks associated

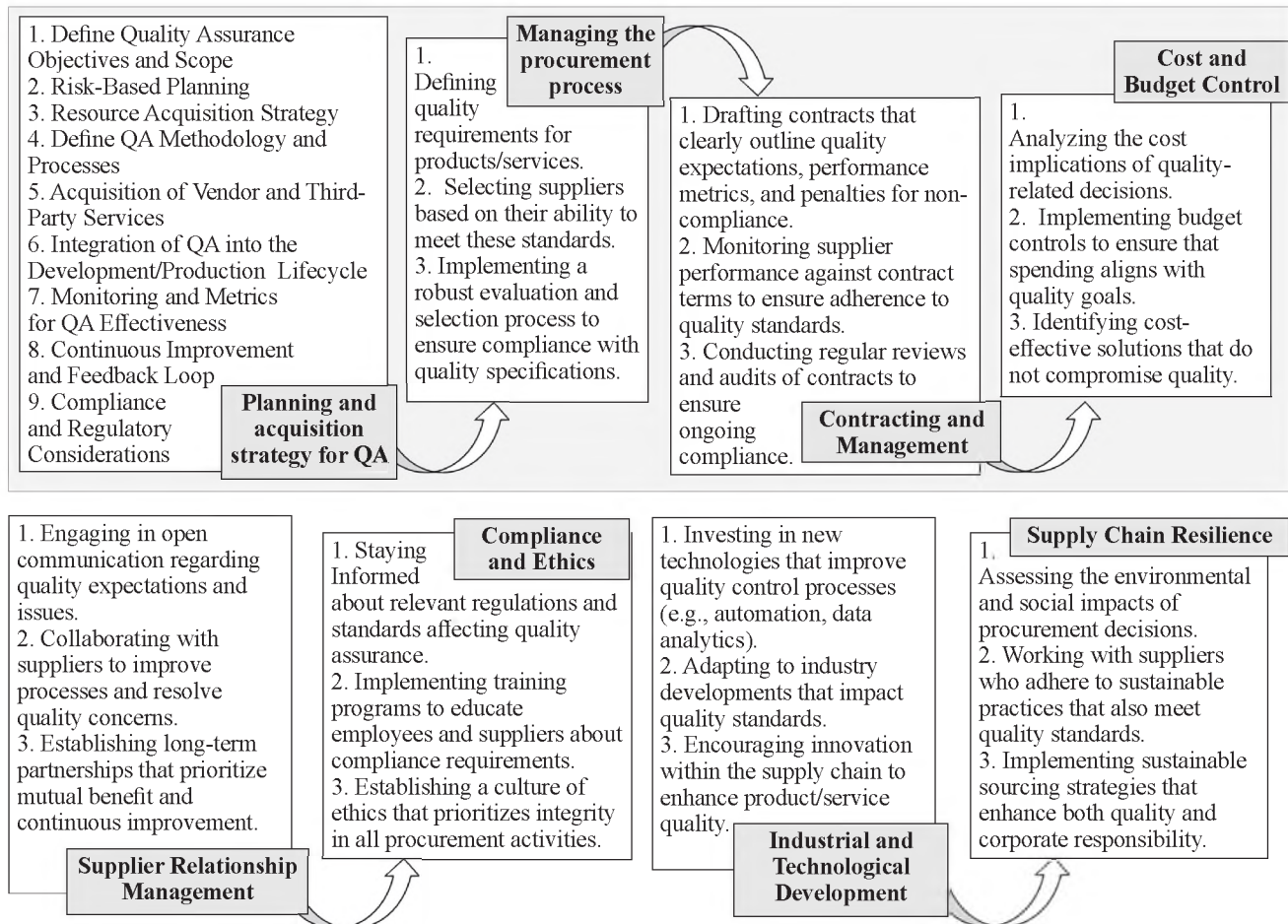


Fig. 8. Key roles and values created by Quality Assurance (testing and conformity assessment)

with weapon usage. It minimizes the likelihood of failures, malfunctions or accidents during critical situations, thereby enhancing the safety and effectiveness of the armed forces.

Building Trust and Confidence. By ensuring quality assurance, this element strengthens trust and confidence among the armed forces, government bodies and other stakeholders in the supplied weapons. It guarantees that procured weaponry is reliable, performs as expected and meets necessary standards, thereby fostering trust and enhancing the ecosystem's reputation.

Adherence to International Standards. Ensures that weapons meet internationally recognized quality and safety standards. This adherence facilitates interoperability with allied forces and seamless integration of weapon systems during joint military operations or multinational exercises.

Continuous Improvement. Promotes a culture of continuous enhancement by identifying areas for improvement in the design, production and performance of weapons.

The quality assurance, testing and compliance evaluation component in the weapons ecosystem creates significant value by:

- ensuring high-quality, safe and reliable weapons for the armed forces;
- mitigating operational risks and minimizing the chances of failure;
- strengthening trust and confidence among stakeholders;
- enhancing compliance with international standards for smoother interoperability and global recognition;

- driving continuous innovation and improvement in weapon systems.

By fulfilling these roles, this element contributes to the overall effectiveness and operational readiness of the military, ensuring that the armed forces are equipped with dependable and high-performance weaponry.

One of the main elements is the Armed Forces [3]. They play a crucial role in the arms supply ecosystem. The key roles they play and the value they create are shown in Fig. 9.

Operational requirements: The armed forces define the operational requirements for the weapons, equipment and systems needed to accomplish the mission. They provide the designation, specifications and performance criteria needed to meet the operational requirements. This ensures that the weapon supply ecosystem meets the specific requirements of the Armed Forces, enabling them to perform their duties effectively.

Capacity development: Armed Forces contribute to the development of future capabilities in the arms supply ecosystem. By actively participating in capability development processes, they help set the direction of research, development and acquisition, ensuring that the ecosystem evolves to meet changing defense needs.

Testing and evaluation: Armed forces evaluate the performance, reliability and suitability of systems in real-world combat scenarios, providing valuable feedback for decision-making and supply chain improvements.

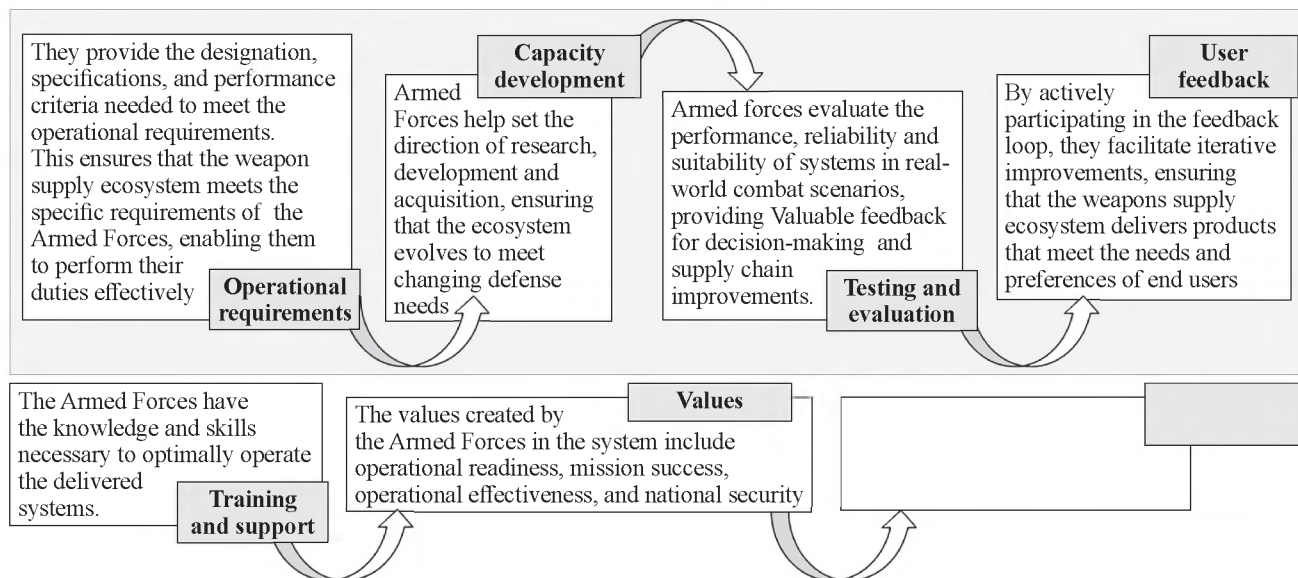


Fig. 9. Armed forces and their critical role in the weapons ecosystem

User feedback: Armed forces provide user feedback on the weapons and equipment they use. By actively participating in the feedback loop, they facilitate iterative improvements, ensuring that the weapons supply ecosystem delivers products that meet the needs and preferences of end users.

Training and support: The armed forces work with the arms supply ecosystem to provide effective training and support for the use of the weapons and equipment provided. This ensures that the Armed Forces have the knowledge and skills necessary to optimally operate the delivered systems.

The values created by the Armed Forces in the system include operational readiness, mission success, operational effectiveness and national security. Their participation in the arms supply ecosystem improves the alignment of capabilities with operational requirements, promotes continuous improvement and contributes to the overall Armed Forces.

Standards and regulatory entities in the arms supply ecosystem play an important role in ensuring conformity, quality assurance and compliance with established standards [3]. Their key roles and the value they create are summarized in Fig. 10.

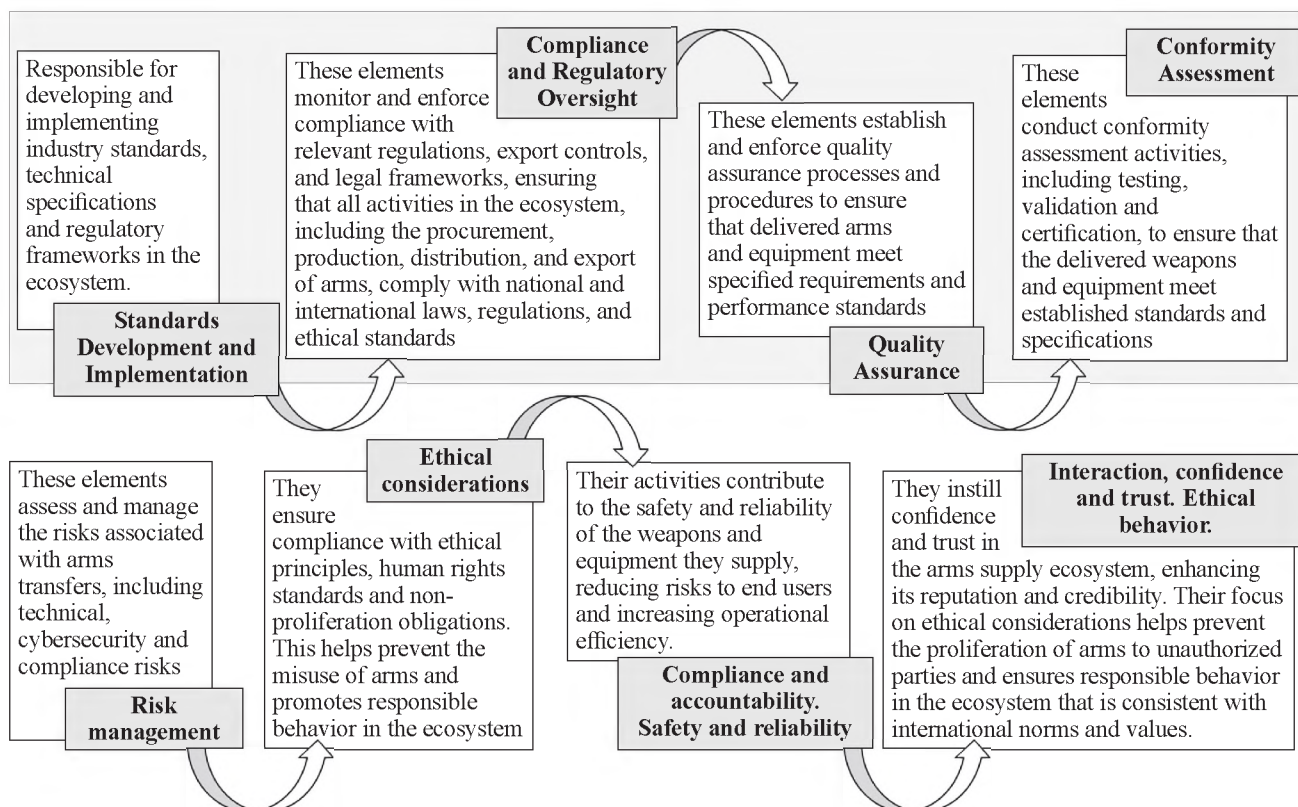


Fig. 10. Key roles and values that create the building blocks responsible for «Standards» and regulatory activities

Standards Development and Implementation: These elements are responsible for developing and implementing industry standards, technical specifications and regulatory frameworks in the ecosystem.

Compliance and Regulatory Oversight: These elements monitor and enforce compliance with relevant regulations, export controls and legal frameworks, ensuring that all activities in the ecosystem, including the procurement, production, distribution and export of arms, comply with national and international laws, regulations and ethical standards.

Quality Assurance: These elements establish and enforce quality assurance processes and procedures to ensure that delivered arms and equipment meet specified requirements and performance standards.

Conformity Assessment: These elements conduct conformity assessment activities, including testing, validation and certification, to ensure that the delivered weapons and equipment meet established standards and specifications.

Risk management: These elements assess and manage the risks associated with arms transfers, including technical, cybersecurity and compliance risks.

Ethical considerations: These elements incorporate ethical considerations into the standards and regulatory activities of the ecosystem. They ensure compliance with ethical principles, human rights standards and non-proliferation obligations. This helps prevent the misuse of arms and promotes responsible behavior in the ecosystem.

The values created by these building blocks include: **Compliance and accountability:** They ensure that all ecosystem actors comply with legal and regulatory requirements, promoting accountability and responsible behavior.

Safety and reliability: Their activities contribute to the safety and reliability of the weapons and equipment they supply, reducing risks to end users and increasing operational efficiency.

Interoperability: Standards and normative activities promote interoperability between different components and systems, ensuring seamless integration and cooperation between armed forces and allies.

Confidence and trust: By establishing and implementing standards, regulations and quality assurance processes, they instill confidence and trust in the arms supply ecosystem, enhancing its reputation and credibility.

Ethical behavior: Their focus on ethical considerations helps prevent the proliferation of arms to unauthorized parties and ensures responsible behavior in the ecosystem that is consistent with international norms and values.

In general, the standards and regulatory pillars play a crucial role in maintaining quality, compliance and ethical standards in the arms supply ecosystem, which ultimately contributes to the safety, reliability and effectiveness of the arms being delivered.

The element responsible for international cooperation in the arms ecosystem plays an important role in facilitating cooperation, knowledge sharing and joining forces with international partners [3, 17]. Some of the key roles and values they create are shown in Fig. 11.

Defense cooperation: The element promotes defense cooperation and partnership with other countries. It facilitates information exchange, joint training and joint research and development initiatives.

Market Expansion: By engaging in international cooperation, the element opens up avenues for market expansion. This provides access to a wider customer base and potential export opportunities for weapons and equipment produced in the ecosystem.

Technology transfer: International cooperation allows for technology transfer and the exchange of best practices.

Risk reduction: Cooperation with international partners promotes a collective approach to reducing security risks. Sharing intelligence, conducting joint risk assessments and

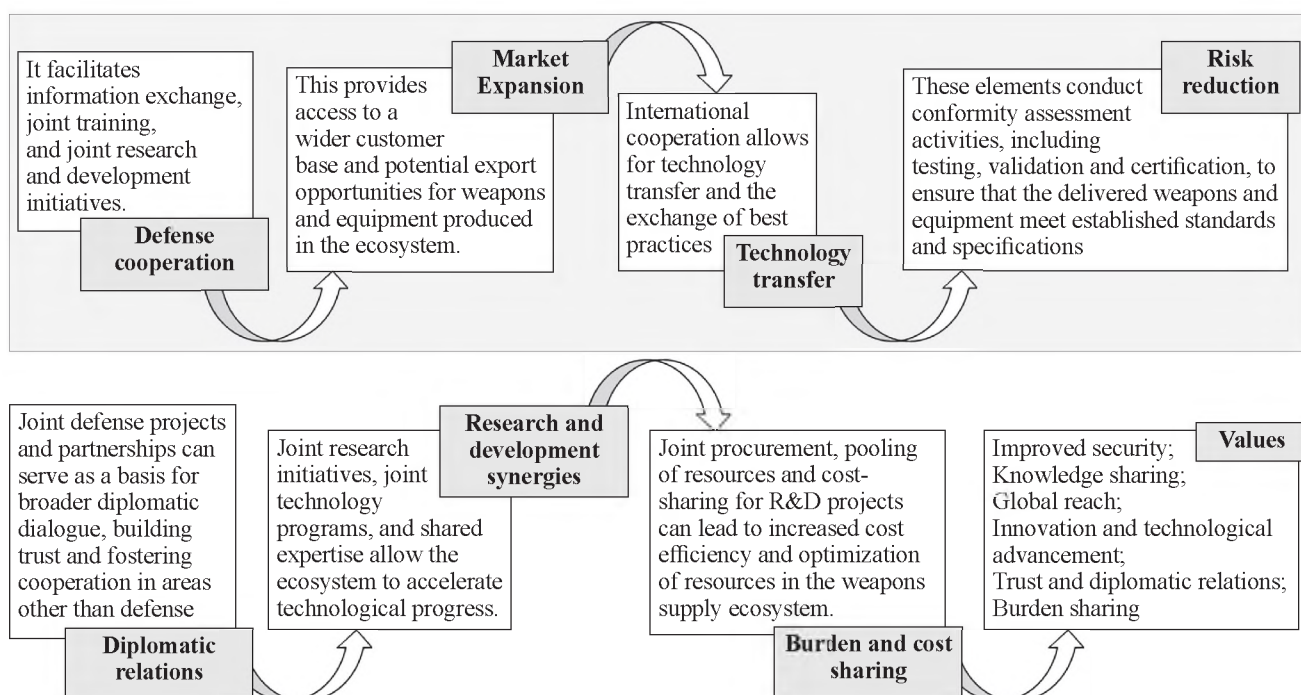


Fig. 11. Key roles and values created by international cooperation in the arms ecosystem

coordinating defense strategies help improve situational awareness and minimize potential threats.

Diplomatic relations: International cooperation in the arms supply ecosystem can also help strengthen diplomatic relations between countries. Joint defense projects and partnerships can serve as a basis for broader diplomatic dialogue, building trust and fostering cooperation in areas other than defense.

Research and development synergies: By working with international partners, the element benefits from research and development synergies. Joint research initiatives, joint technology programs, and shared expertise allow the ecosystem to accelerate technological progress.

Burden and cost sharing: International cooperation allows for burden and cost sharing in defense initiatives. Joint procurement, pooling of resources and cost-sharing for R&D projects can lead to increased cost efficiency and optimization of resources in the weapons supply ecosystem.

The values created by the international cooperation element include:

Improved security: Cooperation with international partners strengthens collective security efforts by contributing to regional stability and addressing common security challenges.

Knowledge sharing: Sharing experiences, best practices and lessons learned contributes to continuous learning and improvement of the arms supply ecosystem.

Global reach: International cooperation expands the ecosystem's reach, providing access to a wider range of markets, customers and resources.

Innovation and technological advancement: Cooperation with international partners fosters innovation, facilitates technology transfer and accelerates the development of advanced defense capabilities.

Trust and diplomatic relations: Cooperation builds trust and strengthens diplomatic relations between countries,

fostering long-term partnerships and contributing to global security.

Burden sharing: Sharing responsibilities and costs with international partners helps to ease the financial burden and optimize the distribution of resources in the ecosystem.

By actively participating in international cooperation, the element contributes to a more interconnected, secure and innovative arms supply ecosystem that benefits participating countries and contributes to global stability.

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CONCLUSIONS

Thus, the main components of Ukraine's future weapons ecosystem can be represented by a symbolic structure (Fig. 12).

Key Elements and Abbreviations:

MO – Ministry of Defense

AF – Armed Forces

WRI – Weapons Research Institute

DRO – Defense Research Organization

DI – Defense Industry

PAA – Procurement and Acquisition Agency

QA – Quality Assurance

ST – Standardization Bodies

IC – International Cooperation

The outlined key elements of the weapons system, along with their roles and values, are presented as preliminary concepts.

Intensive further work on forming Ukraine's weapons ecosystem, as envisioned by the authors, should significantly enhance the efficiency of the state's armament mechanism and its overall defense capabilities.

The proposed approaches align with national security priorities and are expected to position Ukraine as a capable and reliable defense partner on the global stage.

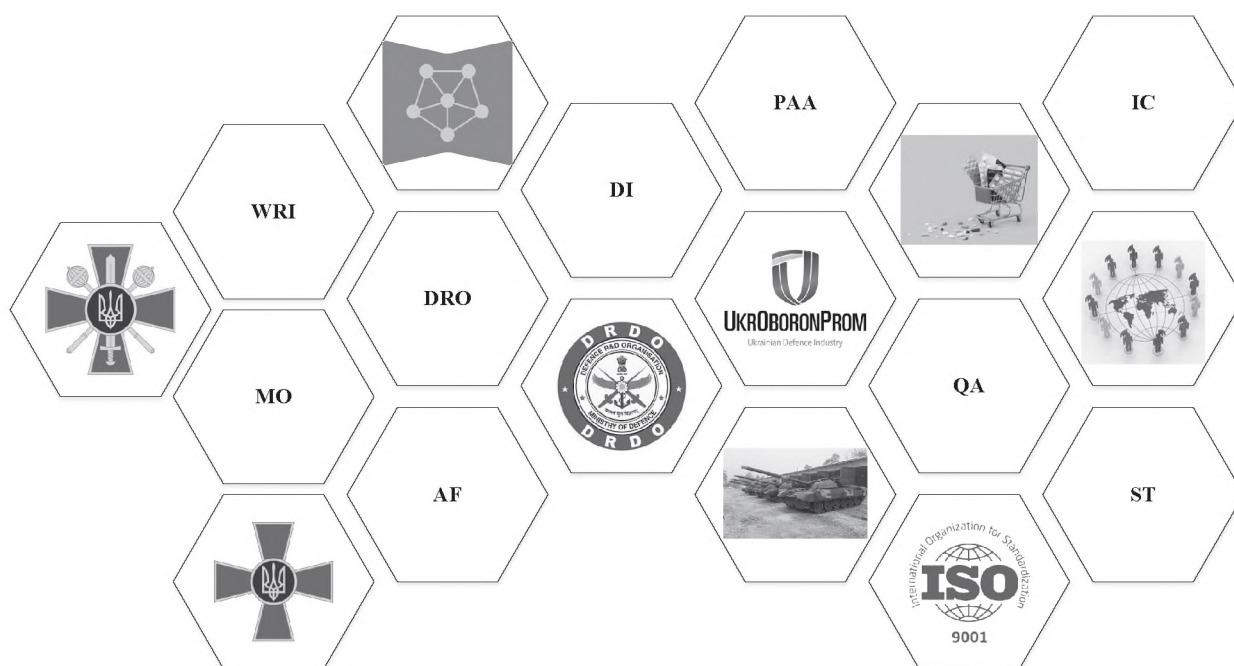


Fig. 12. Components of the Future Weapons System

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СКЛАДОВІ МАЙБУТНЬОЇ ЕКОСИСТЕМИ ОЗБРОЄННЯ УКРАЇНИ

У статті досліджуються формування та розвиток цифрових екосистем у сфері публічного управління як ключовий чинник ефективної цифрової трансформації державного сектору в Україні. Акцентовано увагу на концептуальному розумінні цифрової екосистеми як взаємопов'язаної мережі суб'єктів (державних органів, громадян, бізнесу), які взаємодіють через цифрові сервіси, платформи та інформаційні ресурси. Аналізується роль центральних і місцевих органів влади в побудові цифрових екосистем, а також механізми інтеграції окремих електронних сервісів в єдине цифрове середовище.

Особливу увагу приділено правовим, організаційним і технологічним аспектам створення таких екосистем, зокрема нормативно-правовому забезпеченню, розвитку державних інформаційних систем, електронної ідентифікації, цифрової взаємодії та відкритих даних.

Автори підкреслюють, що сталий розвиток цифрових екосистем потребує цілісної державної політики, інституційної спроможності, кіберзахисту та підвищення цифрової компетентності усіх учасників. Запропоновано практичні рекомендації для вдосконалення цифрового середовища публічного управління в умовах сучасних викликів, зокрема війни та відновлення країни.

Ключові слова: принципи формування елементів озброєння України; основні елементи озброєння України; зацікавлені сторони, відповідальні за розробку та постачання озброєння для збройних сил.

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