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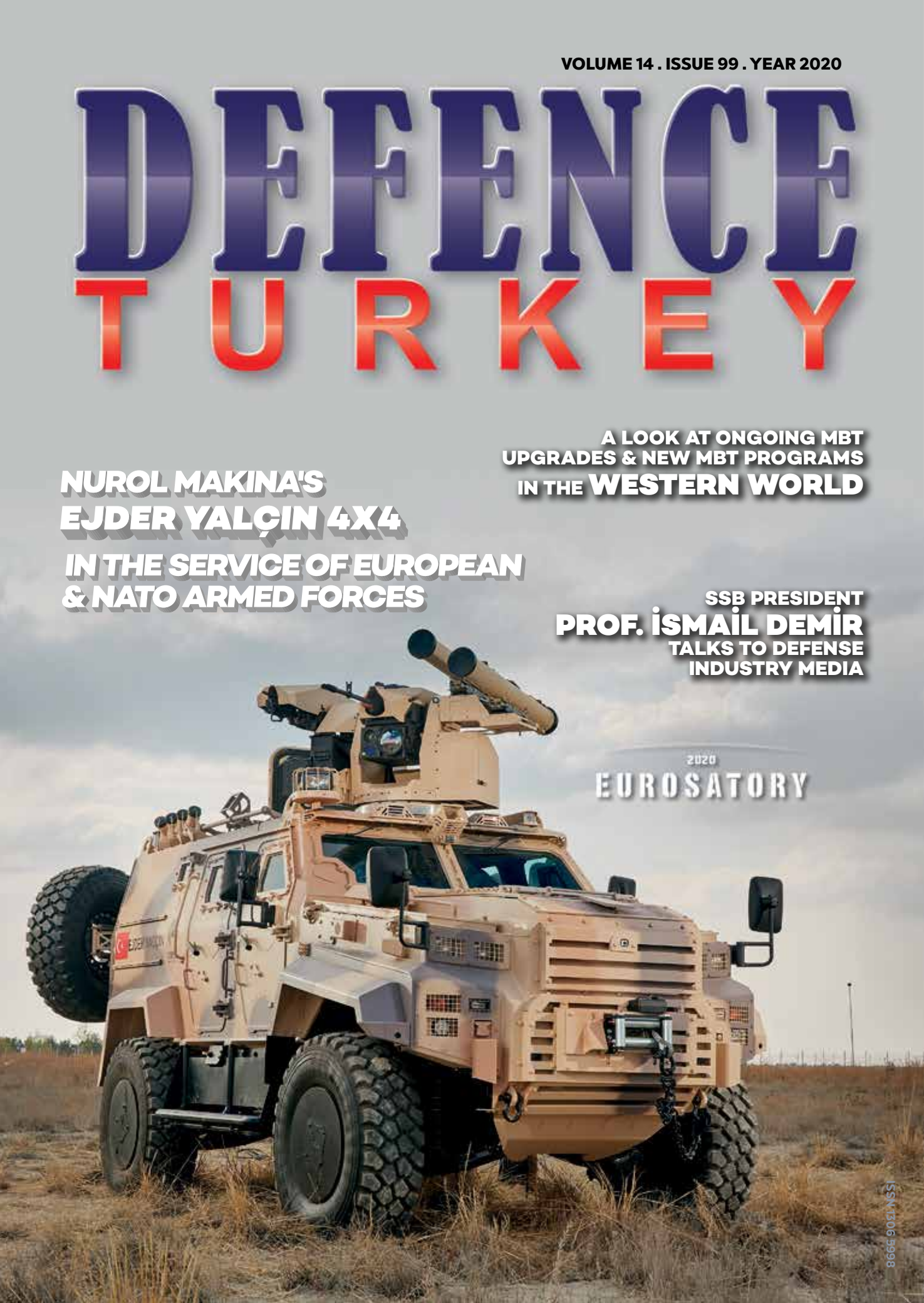
# DEFENCE TURKEY

## A LOOK AT ONGOING MBT UPGRADES & NEW MBT PROGRAMS IN THE WESTERN WORLD

## NUROL MAKINA'S EJDER YALÇIN 4X4 IN THE SERVICE OF EUROPEAN & NATO ARMED FORCES

## SSB PRESIDENT PROF. İSMAİL DEMİR TALKS TO DEFENSE INDUSTRY MEDIA

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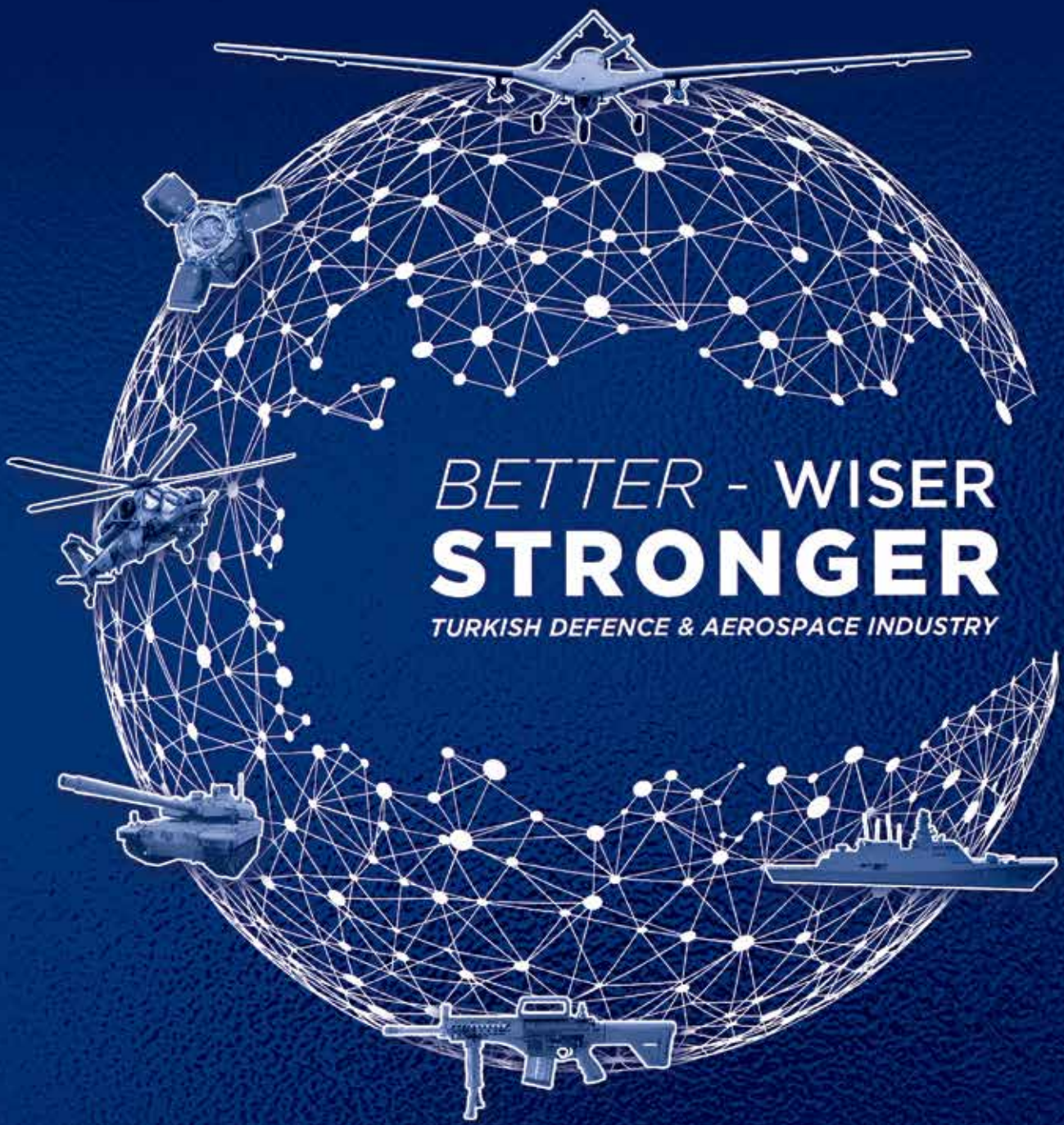


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DEFENCE TURKEY

# DEFENCE TURKEY

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# Will the Effects of the COVID-19 Outbreak Pivot into an Advantage for the Defense Industry?

**Ayşe AKALIN**
Publisher & Editor in Chief

The impact of the COVID-19 pandemic has brought with it an unprecedented state of uncertainty for all business circles and this includes the defense industry as well. Executives and officials are struggling to understand the new situation, facing new challenges. Most global and Turkish defense companies have taken action to protect staff from the COVID-19 virus.

The concept of national security and its different dynamics distinguish the Defense Industry from other sectors. In an interview with the leading magazines of the Turkish defense industry, President of Defense Industries Prof. İsmail DEMİR underlined that critical projects continue in line with the precautions taken against the COVID-19 outbreak, emphasizing that the situation would not be detrimental to the defense of our country. Although work has come to a standstill in various sectors due to the COVID-19 outbreak, the R&D and production activities in the defense and aerospace industry continue uninterruptedly, and the deliveries under the KAPLAN ATV, KARGU-2, Turkish Utility Helicopter, KIRAÇ, HAVELSAN Submarine Command & Control System projects are still ongoing.

It is quite evident that the pandemic will seriously affect the defense industry, however, in some cases, current circumstances have become a pivoting point for companies that are able to branch out to other sectors, turning challenges in other sectors into an advantage. In this context, I believe that this crisis can be turned into an opportunity by transferring the Defense Industry's technological experience and infrastructure to the health sector. In his previous statement, President of Defense Industries, Prof. Dr. İsmail DEMİR, pointed out that patient care, absent treatment, disinfectants, data analysis, analytical modeling, and imaging devices have been determined to be new priority areas of activity. Carrying out R&D studies in the Defense Industry for healthcare opens a new and active area for the sector. Moreover, we also see that the defense industry's work in CBRN, field hospitals, hospital ships, patient transport platforms, and other systems are highly crucial for the development of an ecosystem, consisting of both health and defense industry sectors. As a perfect example, the rapid molecular tests for the COVID-19 virus can now be carried out in Turkey thanks to the indigenous test kits developed by NANObiz TECHNOLOGY Inc.

Meteksan Defense International Sales, Marketing, and Corporate Reputation Director, Burak AKBAŞ wrote a comprehensive and detailed analysis on this issue recently. In his report, he stated that investments in biodefense, government incentives, and R&D studies would increase during this period. In this context, he also emphasized that biodefense provides various opportunities for our defense industry companies and that the studies to be carried out on this issue will contribute to their growth targets.

According to this analysis, two more important issues can be an advantage for the sector: Autonomous systems and blockchain. The increase in the sales of thermal cameras around the world during the pandemic has a had positive effect on companies producing sub-systems and parts for this type of product. A similar situation has been experienced in unmanned systems that are actively used to fight the pandemic and for logistics purposes. According to the analysis, various states have started to implement different digital applications to combat the spread of the virus. Furthermore, it was emphasized that technological tools such as blockchain, face recognition, or data mining are being used more effectively by states, and new opportunities are provided for companies working in these fields.

Although export activities present significant risks during this period, when marketing activities came to a halt, it also brings up changes in the terms of international relations of countries. As stated in the analysis, Turkey's medical aid should not be overlooked, numerous countries benefitted from the assistance and this will certainly have a positive impact future relation with these countries, boosting the outlook for post-pandemic export figures in the long term. Considering that the defense industry is a sector clearly affected by political relations between countries, this situation is certain to be reflected in the sector's trade figures.

Moreover, supply chain disruptions may direct main global contractors to search for new companies during these days when subcontractors are experiencing financial setbacks and facing bottlenecks. Since this situation may be an advantage for Turkish companies, this issue should not be overlooked while projecting new marketing strategies.

I sincerely believe that the Turkish defense industry, which has become a pioneer in various areas such as certification, international marketing, and R&D with its ecosystem, supply chain, nationalization, vast experience, progressive dynamics, and advanced technological infrastructure, will successfully turn this unprecedented crisis into an opportunity with its visionary and institutionalized structure, even during these trying times.

Enjoy this issue...


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# SSB President Prof. DEMİR: "The Transfer of Defense Technologies to the Healthcare Sector has once Again Demonstrated the Level of Our Technological Skill."

**Moving forward by taking the pulse of the defense sector, the SSBs focuses efforts to ensure the ecosystem is kept alive and to prepare Turkish companies for export market opportunities in the future.**

President of Defense Industries Prof. Dr. İsmail DEMİR answered questions from Turkey's leading defense magazines during a live interview broadcast via a domestic video conferencing system on May 7th. DEMİR answered a variety of questions from the Managing Editor of Defence Turkey Magazine Cem AKALIN, Publisher & Executive Editor of MSI Turkish Defence Review Ümit BAYRAKTAR and Editor-in-Chief of C4 Defense Özgür EKŞİ as well as members of the public. During the broadcast, DEMİR made important statements about the plans for the post-COVID-19 period and the future targets of the Turkish defense sector and provided the current status of the defense & aviation projects.

In the first part of the 30-minute interview, topics various were discussed; how Defense Industry companies were affected by the COVID-19 outbreak, how companies adapted to the process, the problems faced by companies during the manufacturing process, cash flow difficulties and company expectations. During the second half the President of Defense Industries answered questions about the development, production, and delivery processes of existing projects.

Underlining that critical projects are continuing thanks to the measures taken against the COVID-19 outbreak and that they are doing their best to ensure all deliveries are made on time, Prof. Dr. DEMİR shared his opinions on which markets the sector will tend to after the COVID-19 period. "We should be dealing with every market where there is potential. There will be no difference in this regard before or after COVID-19. Turkey's humanitarian aid to foreign countries and the measures taken in the field of health changed our perception abroad. We expect this will have positive effects. The transfer of defense technologies to the healthcare sector has once again demonstrated the level of our technological development. We will make use of this recent development in changing the previously disadvantageous perception of the Turkish defense industry. When we talk about the defense and aerospace sector, the civil aviation sector has been profoundly affected by this epidemic, and it seems that this will continue. This may affect our manufacturing companies in civil aviation. I believe that the companies that can recover the fastest are the ones that will come to lead the global market. On the contrary, we do not anticipate such a devastating effect on the defense sector. The experiences gained during the pandemic will result in a broader perception of the defense sector. We are talking about exporting products and solutions to

countries as a package, including elements such as public security, cybersecurity, and vehicle tracking systems."

Stating that there have been significant changes in the working order of several companies in the defense sector as part of the measures taken against the COVID-19 pandemic, Prof. Dr. DEMİR gave information about the work carried out regarding the problems that may occur in production processes and the financial situations of companies. "We plan to provide psychological relief. We are working on a model in which the situation of each company will be addressed separately, and the necessary steps to be taken will be determined accordingly. For example, we have obtained a special work permit in line with the demands of our companies so that the curfew does not disrupt their activities. We are very responsive to the issue of cash flow. As you know, we have numerous projects underway. Our main priority is to ensure that no one loses their job. One of the main tasks of the SSB is to support the defense sector to ensure the sustainability of the ecosystem. We are taking the necessary measures in this regard, and we want our companies to get in contact with us. We want to ensure their sustainability." Stressing that businesses in various sectors have come to a halt due to the COVID-19 pandemic, DEMİR emphasized that the R&D and production activities in the defense and aerospace sector have continued without interruption. "Our deliveries are continuing. We have supplied various platforms such as KAPLAN ATV, KARGU-2, Utility Helicopter, KIRAÇ, and the HAVELSAN Submarine Command and Control System. UAV production is also continuing, and we have signed a subcontractor agreement for the TF-X National Combat Aircraft. There have been some minor disruptions, but they have originated abroad. We are keeping the impact to a minimum, and we place utmost importance in avoiding disruptions in our strategic projects."

**Prof. DEMİR: "We will Need Significantly More Resources, Especially for Indigenous Projects Such as the Main Battle tank and Aircraft Engine as well as the 5th Generation Jet Fighter."**

Referring to the expectations of the defense industry for 2020, Prof. Dr. DEMİR stated that efforts are underway to increase revenues in the Defense Industry Support Fund, considering the financial value of the ongoing projects. "There have been efforts to increase the fund because the number of projects continues to increase, requiring more resources. As the number of projects further increases in the future, we will need significantly more resources, especially for indigenous projects such as the tank and aircraft engine as well as the 5th generation jet fighter. This issue is on the agenda of the Defense Industry Executive Committee (SSİK)."

Underlining that the T129 ATAK projects for Pakistan and the Philippines and the ALTAY Main Battle Tank project cannot be finalized due to the embargoes, DEMİR stated that these issues are the main reasons for the emphasis on "National and Domestic" concepts. "In the current situation, embargo is a word that is not spoken of, but rather, it is applied. This is the reason for our emphasis on national and indigenous concepts. We have been predicting this for a long time. We must develop an independent defense sector, and we are cooperating in joint projects in which technology is being transferred, but when Turkey applies its national policies, we encounter obstacles. The steps taken by Turkey to protect its national interests are responded to with strange attitudes of friendly and allied countries. However, Turkey relies on its people, and we rely on our engineers. We have already started our studies to overcome these problems. We have our plan B and C. We continue our dialogue with those countries, but the obstructive attitude damages all those involved. We will continue our export activities. As you know, we are not a country that has designed many aircraft in the past. We are designing a fifth-generation aircraft as our first endeavor, and this will take some time."

Sharing information about ongoing naval projects, DEMİR stated that it is time to turn to autonomous systems in naval platforms. "Our national submarine project is continuing. Today, we have a better understanding of the importance of Blue Homeland. Construction activities are continuing at the shipyards of both the Turkish Naval Forces and in the private sector. The systems to be installed aboard the vessels are also extremely important, and in this area, we will break our dependency on foreign systems such as engines. We launched the submarine construction project with the Germans, and we will continue in this way if the foreign countries continue; however, if we encounter reluctance, we will continue the project on our own. We emphasize that both parties should always be constructive in relationships and projects. While the companies with which we are engaged in joint projects are willing to do business with us, their governments' decisions and obstacles prevent them from doing so. We have ongoing work and competitions for unmanned surface and submarine systems, and we believe the time has come for autonomous naval systems. We direct our young people to conduct research not only on aerial platforms but also on land and naval platforms as well."

Regarding the changes that may be experienced regarding the role of our country in the international arena, İsmail DEMİR mentioned the new developments that may occur in terms of international cooperation in the coming period. "It is possible that we will reap the first fruits of our activities and support in the F-35 project in the future. Turkey's performance, as well as its

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*HİSAR-O - Medium Altitude Air Defense Systems*

accurate execution of the work, will contribute to this. Regarding international relations, we are collaborating with other companies from which we have received design and engineering support. We are now entering a period in which we will witness the support of the parties to each other. We have a model in which all activities will benefit from a win-win relationship." Underlining that Turkish defense sector companies have undertaken significant work packages under the F-35 project, DEMİR shared information about how Turkish defense and aerospace companies will be affected by the removal of Turkey from the F-35 program and the precautionary plans the SSB has put into place to reduce these effects. "In the F-35 project, the date planned to stop production was March 2020, but that has not been implemented, and our companies are continuing their work. These dates will be reconsidered. As can be seen, the situation does not have an easy solution. We are a loyal partner of the F-35 project, and the contribution of Turkish companies can clearly be seen. Thus, we do not believe the existing approach to Turkey's departure from the program will continue. We are keeping with production, and we will not break our relationship."

**Prof. DEMİR: "Regarding HİSAR-A and HİSAR-O, the Need for These Systems has Become All too Apparent During Recent Operations, and We Have Seen that the Need for A Medium-Altitude System is More Urgent."**

Speaking about the current status of Turkey's ongoing projects, DEMİR stressed that Turkish companies are undertaking the maintenance and sustainment of the S-400 system. "Our main target for the TF-X project is to utilize Turkey's capabilities to the maximum extent possible. We remain in contact with all partners, and especially the major defense companies and TÜBİTAK (The Scientific and Technological Research Council of Turkey). The utilization of foreign subsystems, even only in the transition process, would obstruct us in the future. We will not rely on any foreign systems in the future, as no matter how binding the agreement, there can be blockages. We have had our fingers burnt before in similar situations. Making every system indigenous is a costly process in the global system. In the first phase, we will use an off-the-shelf engine, but the final engine will be indigenous. The HÜRJET project remains on the agenda, and work continues on the prototype. Our negotiations with another country regarding ALTAY MBT are ongoing, and we can say that it is only a matter of time until we sign an agreement. For the engine, we have a plan B and even a plan C. We are still working on this. On the other hand, the decision as to whether we go with an electric engine or a hybrid engine is still on the table. Regarding HİSAR-A and HİSAR-O, the need for these systems has become all too apparent during recent operations, and we have seen that the need for a medium-altitude system is more urgent. HİSAR-O has become operational in the field with certain elements, but there is still work to be completed. Our work on torpedoes is continuing. We expect the serial production of ATMACA to begin soon. The studies on land vehicles are also continuing, and the F-16 AESA radar project is also moving forward. The structural modernization work on the aircraft will be carried out by Turkish Aerospace. There has been no request to extend the lifecycle of the F-4 Aircrafts, but studies are also underway to look at the potential. The modernization of C-130s is continuing. We have a Jet UAV project and various UAV studies of different sizes. There are also several different UAV projects on our table, such as mini and micro UAVs, swarm UAVs, and ship-based UAVs. We are also working on future air combat concepts in which different UAVs undertake different tasks while conducting Electronic Warfare. Turkish companies will definitely be responsible for the maintenance and sustainment of the S-400 system. Training courses are continuing to a limited extent. Deliveries of the system were completed last year. Although the supply agreement includes items such as training, maintenance, and sustainment, Russian personnel will not be able to access the S-400 batteries

as they wish. This is our red line. Every part of the system or every work that involves the system will be under the responsibility of Turkey."

Indicating that the infrastructure work is continuing for the commissioning of the S-400 system, DEMİR said that the project will become operational step by step. DEMİR also underlined that the training processes were hindered due to the COVID-19 outbreak. Stating that the second phase of the project, which is the negotiations on joint production, are underway, DEMİR added that technical details regarding this issue are still being negotiated between the parties.

Underlining that the capabilities and infrastructure of the defense sector can be adapted to other fields, especially the field of CBRN, DEMİR provided information about what will steer the activities of the industry in the post-COVID-19 period. "The healthcare sector is a field with its own dynamics. Regarding how defense technologies can serve in this area, we have identified 4 areas:

- Patient care and remote treatment
- Disinfectants and Antivirals
- Data analysis and data analytics modeling
- Imaging devices

These will be our contribution to the healthcare sector, and we have launched various R&D studies in this regard. The national and indigenous model adopted by the defense sector will also be implemented in the healthcare sector. In public procurements, it is our recommendation and priority to make purchases considering indigenous products, regardless of time. Preferring foreign products to obtain rapid results will not be healthy in the long term."

## Prof. DEMİR: "There is no Problem with the Supply of F110 Engines"

During the live interview, President of Defense Industries Prof. Dr. İsmail DEMİR also took questions from the viewers about TF-X prototype engine selection and indigenous engine development, İSTİF (İ)-Class Frigate Project serial production process, Turkey's role in F-35 JSF F-135 Turbofan engines Depot-Level (D-Level) Maintenance, Hisar-A serial production process, the current status of the Hisar-U (SIPER) project, and Long-Range Air Missile Defense System identification studies with EUROSAM. "All elements of the F-35 project have been suspended, and as such, the work at TEI has also ceased. We have started working on the TF-X engine, but the F110 engine will be used in the first phase. We consider a twin-engine design. Currently, there is no problem with the supply of F110 engines, which is an engine that we know very well. 5-6 engines have already been supplied. It is an engine that TEI has extensive experience in maintaining and repairing, so we feel it would be safer to start with this engine. Work on an indigenous engine is currently underway, but we are also in contact with numerous countries about the jet engine. An agreement was signed with EUROSAM for identification studies. This collaboration included a more comprehensive identification study for our needs based on the EUROSAM SAMP/T, but we have determined that it will not be the SAMP/T system. The identification study is practically complete; we are waiting for the results to be signed. After that, the process will continue. We are at the stage of initiating studies towards how we will proceed to meet the needs of all three countries. For the I-Class frigates, the design is ready, and we are prepared to move to the construction phase. When we started the process, we decided to build 4 ships. We are considering the shipyards of both the Turkish Naval Forces and the private sector to construct the other 3 vessels. We have already prepared the necessary roadmap for the process to proceed fast. The moment we get the green light and the funds, we can open a tender and start the process. Regarding HİSAR-A, we changed the Hisar-A orders to Hisar-O due to the need for a medium-altitude air defense system in the field. We will reduce the number of Hisar-A orders. We started the serial production of Hisar-A; however, we will modify it for the Hisar-O system. So yes, the serial production of Hisar-A has been practically started. The experience we gained in the HİSAR-A and HİSAR-O will be transferred to SİPER. Equipping these


*The Mock-up of Turkish Fighter Aircraft & F-110 Engine*

missiles with longer-range radars and seekers is also on the agenda. Our institutions continue to work on this. As you know, the project has a predetermined schedule. In the meantime, we have an ongoing process for Man-portable air-defense systems (MANPADS). The systems are expected to be delivered soon."

### Prof. DEMİR: "GEZGİNs will be Effective at Longer Distances and will be Equipped wither Higher-Impact Warheads"

Answering questions about other important projects, İsmail DEMİR stated the following in the second part of the interview: "We will complete the entire ATMACA family. GEZGİNs will be effective at longer distances and will be equipped with higher-impact warheads. Of course, the critical threshold here is the engine. Our engine studies for ATMACA and SOM are in a good situation. Their bigger versions will also slowly be on the agenda. It is vital to master the essential elements of cruise missile technology, and we have achieved it. Our companies continue to increase their capabilities in critical technologies for the localization of important systems such as INS. Regarding the guidance technologies, we will be taking the matter into our own hands. A land-based new version of the ATMACA missile will also be developed. The larger versions of our cruise missiles to be developed in the future will have both a stronger warhead and extended range. We are carrying out studies on warfare technologies based on our experience in the field. We have established our explosive and ammunition road map, and we believe that we should not lag-behind in this area. Our main goal is to equip the I-Class Frigates with indigenous weapon systems as much as possible. We may equip the first ship with only GÖKDENİZ and ATMACA, but for the next three vessels or TF-2000, we want the national vertical launching system and domestic air defense systems that Roketsan will integrate. We will integrate indigenous weapons as the systems evolve. Domestic and National products require a little patience. I want to thank the Armed Forces for their stance on this issue. There has not been a request for TRAKYA (LHD) yet, but it is possible to start if our shipyards are ready. We do not currently have a second LHD project. The construction process of TCG ANADOLU continues according to the schedule."

*F-515 I-Class Frigate*

DEMİR assessed the economic effects of the COVID-19 outbreak, the future of the Land Vehicles Sector and Cybersecurity in the post-pandemic period in the closing part of the live broadcast. İsmail DEMİR gave information about delays in payments, efforts to reduce foreign dependency in the Land Vehicles Sector and activities to raise awareness in the field of cybersecurity. "We are quite strong in the land platform sector, however, the steel that is specifically used for the armor of our land vehicles comes from foreign sources. OYAK has initiated a new process that we expect to yield results. The second is engine and transmission systems. We strongly stress that domestic power packs should be used in land platforms. It is incredibly important for us to have the armor, engine, turret, and optical systems produced indigenously. After this has been achieved, we will be able to enter foreign markets. Of course, we are developing very important subsystems and equipment such as Command Control systems for these vehicles. We are also raising awareness of the importance of cybersecurity. We have a 149-member cyber cluster. The use of domestic products in the field of cyber defense and security currently is very low in Turkey. We need indigenous products in the field of cyber defense and cybersecurity. Moreover, for the evaluation and auditing of our cluster members, we will introduce a model like the Industrial Competency Assessment and Support Program (EYDEP). Recently, our defense sector companies have been subjected to cyber-attacks. These incidents have convinced us that the defense industry was deliberately targeted; thus, we plan to support our companies with the capacity we will create within the cluster. Regarding payments, we do not expect a delay linked directly to COVID-19, but if there is a delay in deliveries, payments will also be delayed. As a result of the increasing number of projects, the Defense Industry Support Fund should be updated. We are following every process to ensure the ecosystem is kept alive. It is vital that nobody is victimized during payment prioritization, and that jobs are not lost. This period has placed a burden on all countries, and Turkey is no exception. At this point, we must move forward while taking the pulse of the sector. There will be various opportunities in export markets, and our companies should be prepared for this"


GLOBAL
EXPERIENCE
IN LAND SYSTEMS
Koç
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# GÖRGÜÇ: "Our Exports Accounted for 64% of our Turnover in 2020 Q1 Reaching US$ 48 Million"


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**We present our readers with an interview we held with Serdar GÖRGÜÇ, Otokar General Manager, on the company's 2020 Q1 performance. The company is also celebrating its 57th anniversary of establishment this year, during a period overshadowed by the COVID-19 pandemic. We discuss the company's target markets for the Commercial Vehicles segment and the Defense Industry and its ongoing export activities.**

**Defence Turkey: Otokar is Turkey's first private Defense Industry company and the leading tactical wheeled vehicle manufacturer of the Turkish Defense Industry and celebrates its 57th anniversary of establishment this year. Could you please evaluate Otokar's 57th anniversary with figures? Can you share some details about Otokar's significance in Turkey and in the area of commercial and military vehicles?**

**Serdar GÖRGÜÇ:** Since Otokar's establishment in 1963, in an era where Turkey's industrialization and modernization efforts started, the company has been offering tailored solutions to its customers with its own technology, design and applications.

With the responsibility both for our country and our users, we have accomplished numerous fruitful projects over the last the 57 years. We made our mark on commercial vehicles as well as in Defense Industry projects and we are proud of each of these achievements. With this mindset and our sense of responsibility, we have been steadfast and focused on representing our country in the Defense Industry abroad. We have won many challenging projects, beating out international competitors and have successfully fulfilled various projects on a global scale. As a result of the investments we have made, our engineering and production capabilities as well as our flexibility in manufacturing products that are compatible with user requirements, we have become a pioneer both on the commercial side and in the Defense Industry as well.

Presently, Otokar exports Defense Industry products to over 35 countries. With all intellectual property rights over the products, the company exports its tactical wheeled vehicles, tracked armored vehicles and turret systems worldwide. Otokar makes a difference with the help of its know-how, engineering, R&D, and technology transfer capabilities in the Defense Industry. In terms of commercial vehicles, Otokar owns Turkey's top selling bus brand. Conducting activities also in alternative fuel buses, Otokar manufactures light trucks for the logistics sector as well.

Otokar achieved record growth of 45% in 2019, increasing its turnover to TRY 2,4 billion (US$ 353 million). As Turkey's only unique land systems manufacturer and a company without a foreign partner, we also continued to export armored vehicles that we designed and manufactured in Sakarya in 2019. This year we doubled our Defense Industry exports. We accurately analyzed user expectations and requirements and carried out our production activities accordingly. Otokar has strengthened its position in the regions that it operates through partnerships and affiliates, which has had a positive impact on its growth in 2019.

In 2019, our R&D expenses reached TRY 136 million (US$ 20 million). Meanwhile, we continued our efforts to develop new products. While including the Special Operation Vehicle configuration of URAL to our product family, we added the AKREP-II to our armored vehicle product range. We revealed the Turkey's first electric-powered armored vehicle AKREP-IIe and ran its promotion activities.

**Defence Turkey: Could you evaluate Otokar Defence's overall performance in terms of Indigenous Solutions, Exports, R&D and Test Assessment Infrastructure?**

**Serdar GÖRGÜÇ:** As Otokar, throughout the 33 years we have been active in the Defense Industry, we have always targeted better achievements and

have operated with this motivation. The Turkish Defense Industry has taken critical steps recently in terms of exports and product development.

As the leading company in land systems, we analyze end-user expectations and requirements and conduct our design, development, and production activities accordingly. We fully own the intellectual property rights to our products and our military vehicles are actively being utilized by over 50 users in over 35 countries, and particularly in our country, and this fact is a great source of pride for us.

Otokar has adopted a corporate philosophy of being a pioneer in the areas in which it operates, thus we have always led the way in Turkey. Otokar was the first company to develop computer-based design in Turkey, to manufacture Turkey's first tactical wheeled armored vehicle and indigenous tracked armored vehicle while being the first company to produce Turkey's first electric-powered armored vehicle. All such are quite critical developments for our country's industry.

Otokar R&D Center is equipped with simulators, testing equipment and computer systems that generate and evaluate data to enable more rapid testing of the manufactured vehicles in an environment with state of the art technology. Otokar's R&D capabilities include the use of CAD software for product development, prototype workshops and software,

*Otokar Electromagnetic Compatibility (EMC/EMI) Test Center*

computer-assisted analysis and simulation software, test mechanisms and software. Otokar R&D Center is a major source of pride for us as it embodies Turkey's first and only Dynamometric Conditioned Test Room which is also one of very few of these types of facilities found in Europe, and the Hydraulic Road Simulator which has the highest capacity in Turkey, and Turkey's biggest and the world's most modern Electromagnetic Compatibility Test Center. The Otokar Electromagnetic Compatibility (EMC/EMI) Test Center simultaneously serves as an independent accreditation center for Defense Industry R&D projects in Turkey and abroad.

With an aim geared toward the development of new equipment and applications that are in line with requirements of the future, Otokar has allocated 8% of its turnover to R&D activities in the last decade. The total R&D expenses of our company over the last 10 years reached TRY 1,1 billion (US$162 million). Due to all these capabilities and R&D investments, Otokar reveals products that make difference not only in our country but also abroad. We will continue in this manner, as we embrace the future making smart and effective investments in order to truly become a company that is ready for the future and one which also leads the future.

**Defence Turkey: Otokar is a global company with 100% Turkish capital and it has been providing tailor made solutions to fulfill the requirements of its customers with its own technology, design, and applications since 1963. Manufacturing buses for public transportation and light trucks for transport and logistics industries, Otokar is also currently manufacturing wheeled and tracked armored vehicles in various configurations within the defense industry. Could you share your opinions on the advantages/ disadvantages of being a company operating both in the civil area and defense industry? What is the current balance of Otokar's activities between the civil side and the defense industry and what is the domestic/international breakdown?**

**Serdar GÖRGÜÇ:** Operating in two different areas is a strategy for Otokar that was adopted to achieve sustainable growth. Defense Industry projects involve orders which sometimes can span over many years, and the projects can contain distinct differences in demands on a yearly basis. Commercial vehicles and especially the heavy commercial vehicle group that we are active in is a relatively steady and labor-intensive area with sales lower than the overall automotive industry. On the other hand, it is an area rapidly affected by economic fluctuations. By balancing each other, these two different industries maintain Otokar's robust and sustainable growth.

This is a strategy adopted by many Defense Industry companies across the world. The existence of the defense industry,

by focusing only on internal market demand and operating for a single customer is not economically possible in the present conditions and in the long run. In our opinion, Defense Industry companies should not be dependent on the state for maintaining their existence, and the state should not allow the companies' transformation into structures that would become a burden on the state. Support provided to the companies by the state should not imply the enablement of the survival of the companies through projects that are not cost-efficient. I believe that profitable companies with high credibility would be always contributing positively to the development of the industry. Therefore, the companies in the industry should be focusing on becoming globally competitive and self-sustained companies that are not dependent on a single supplier or a source. We believe it is critical for companies to have full knowledge of the technology and own it in order to carry on and establish structures that are resistant to yearly and periodic economic fluctuations, structures that are capable of manufacturing civil/commercial and military products that do not depend on a single product or a single user. Otokar can be regarded as one of the successful examples of this strategy.

Our target is for an equal balance the share of commercial vehicles and Defense Industry products in our turnover, half and half. Surely, the rates on a yearly basis may vary due to the projects. In 2019, the share of both product groups within our turnover resulted in similar percentages.

**Defence Turkey: What would you like to say on Otokar's presently achieved and targeted local content rates and the utilization of sub-industry in 'Turkey's Land Systems Provider?'**

**Serdar GÖRGÜÇ:** It is impossible to consider a manufacturer, which develops products with fully owned intellectual property rights, separate from the sub-industry and suppliers. Main industry and sub-industry form a whole. Otokar focuses on the final product in its relations with its suppliers and assigns the design and development of the sub-components to them under its control, and in this way increasing their competency. It also informs its suppliers by constantly following innovations in the sector. In the same way, it supports the suppliers by promptly evaluating and activating the projects proposed by them. Otokar endeavors to improve its suppliers not only during the product design and development stage but also in logistics and resource planning areas as well. Otokar's relations with its suppliers are based on such approaches. Collaborating with suppliers that neither develop products with our company nor take part in our design process is quite challenging for us. We wish for our suppliers to improve, develop, and grow along with us.

**Defence Turkey: The Novel Type Coronavirus (COVID-19) first identified in Wuhan city, China in the last quarter of 2019 rapidly spread across the globe causing a staggering number of deaths in nearly 190 countries and deeply affected the business world and our daily lives. Could you inform us on Otokar's actions regarding the COVID-19 pandemic, the measures it has adopted and its ongoing applications?**

**Serdar GÖRGÜÇ:** From the outset of the COVID-19 pandemic, we, as Otokar, initiated to adopt the required measures to minimize the impacts of the pandemic, to prevent the spread of the, primarily to keep health of our employees while maintaining the sustainability of our business. Within the scope of these measures, we

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*COBRA-II*

set up emergency action plans and conducted the relevant preparations. We took actions that focus on measures regarding our activities within the company and those performed with external shareholders. A Coronavirus Information Center has been established under the management of our on-site doctors and our employees started to be informed on the pandemic. We have been regularly communicating with both our employees and our business partners. We designed the production on a shift basis and reduced the number of our employees in each shift. We adopted all types of measures to adhere to social distancing guidelines in all our production areas and in all common spaces. Hygiene and personal protection measures have been taken at a maximum level in all areas from shuttles to dressing rooms, from cafeterias to resting places. We continue to distribute disinfectants and masks required for personal hygiene. The body temperature of employees are being monitored by thermal cameras in the entrance of the premises and in various areas throughout the day. We are strictly implementing all preventive measures.

**Defence Turkey: Are there any changes in Otokar's operational plans for 2020 due to this unprecedented pandemic?**

**Serdar GÖRGÜÇ:** All industries were adversely affected by the pandemic. We have already designed alternative plans for all types of potential cases, however for the time being it is too early to assess the impacts... We are carrying out our activities in line with the existing contracts and orders we have received, and within the frame of the measures we have adopted.

*TULPAR Infantry Fighting Vehicle Configuration fitted with Mızrak 30mm Turret*

**Defence Turkey: Can you touch on the progress of the Otokar's overall business this period, and how are the new contract and delivery processes being managed?**

**Serdar GÖRGÜÇ:** All our processes, such as production and delivery, continue within the framework of specific measures and by implementing all social distancing and hygiene rules. There are no alterations in our existing activities and contracts. Just like all other corporations, we set various new rules such as the number of participants and the duration of our meetings in an effort to prevent the spread of the virus while conducting in our daily activities.

**Defence Turkey: Otokar is a company with affiliates in foreign countries such as France, United Arab Emirates (UAE), Romania and Kazakhstan. Are there any setbacks or delays in the projects and activities you execute at your companies and offices abroad due to the COVID-19 outbreak?**

**Serdar GÖRGÜÇ:** We implemented all types of measures to protect our employees at our affiliates as well. There have been no setbacks or delays in our ongoing activities in the regions you mentioned.

**Defence Turkey: What would you like to tell us about the future? Could you share your projections, Otokar's targets and expectations for the year 2023, the year our Republic will be celebrating the 100th anniversary of its foundation and Otokar celebrates**

*TULPAR Light Tank Configuration fitted with CMI's Cockerill 3105 type Turret*

**its 60th anniversary of establishment? Can we expect any announcements, any surprises perhaps?**

**Serdar GÖRGÜÇ:** Otokar is a company that has always based its progress on the philosophy of excellence which it has adopted in all its operations. We are working toward constant progress and achieving better results. As I mentioned previously, Otokar allocated 8% of its turnover to R&D activities in the last 10 years. The 10-year R&D expenses of our company reached TRY 1.1 billion. We will be continuing our design and development activities in the upcoming years without compromising this mindset. As Otokar, we will continue to reveal products that create a difference not only in our country but also in foreign countries. We aim to further strengthen our position among global brands with the assistance of our wide range of products, technology, design, and engineering capabilities. We wish to increase our growth in foreign countries with new achievements while also taking advantage of various types cooperation opportunities such as joint product development, local business partnerships, local production and technology transfer with our foreign affiliates.

**Defence Turkey: Like in all other areas, the COVID-19 pandemic has caused negative effects in exports and significantly impacting trade. According to the data provided by the Turkish Exporters Assembly (TİM), exports of Turkish Defense and Aerospace Industry fell by 49.8% in March compared to the previous year. Could you evaluate Otokar's first quarter of 2020 (in terms of turnover and export figures) and could you define the picture you see when you compare the recent figures with those of the previous year?**

**Serdar GÖRGÜÇ:** We can say that Otokar's performance in the first quarter of 2020 has been better than the previous year. By achieving a turnover of TRY 459 million in the first quarter, we realized 9% growth compared to the same period of the previous year. Foreign sales constituted 64% of our turnover in the first quarter of 2020, reaching US$ 48 million.

**Defence Turkey: Considering that potential markets/ customers are also affected by the COVID-19 outbreak, will the Company be updating turnover and export targets/figures set for 2020?**

**Serdar GÖRGÜÇ:** We made our plans according to different scenarios. We are also going through a period where positive steps are being taken towards normalization. It is quite soon to make a concrete projection.

**Defence Turkey: Could you inform us on the target markets that Otokar has identified in the Commercial Vehicle and Defense Industry segments as well as the tenders that are being followed and the requirements in this area?**

**Serdar GÖRGÜÇ:** The Middle East, Asia, Gulf Countries, North African and South American regions are amongst our target markets in terms of the Defense Industry. Depending on each market's demands, our 4x4 wheeled, 8x8 wheeled and tracked armored vehicles are drawing interest. We can say that Africa and Asia and particularly Europe are our target markets for commercial vehicles.

**Defence Turkey: Could you inform us on the ongoing export activities and those expected to be contracted soon? For instance, we came across some news on social media in April that Otokar exported 40 ARMA 8x8 TTZAs to a country in the Middle East. What more can you tell us about this?**

**Serdar GÖRGÜÇ:** Over 32,000 vehicles, the intellectual property rights of which are fully owned by Otokar, are operational

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*ARMA 8x8*

in more than 35 countries. We have accomplished new and crucial success in terms of exports in the recent period. In 2019, we doubled our Defense Industry exports compared to the previous year. In this period, we have focused on the delivery of the orders we received previously; without doubt there are many ongoing projects and projects we have been following in our target markets.

**Defence Turkey: What is the latest status of the AKREP IIe and URAL Special Operation Vehicle Projects that were launched in 2019 and is there domestic and foreign interest in these two vehicles?**

**Serdar GÖRGÜÇ:** We received quite positive feedback regarding these new vehicles during IDEF 2019 and following the event as well. The cancellation of this year's fairs affected the promotion of our new vehicles adversely.

**Defence Turkey: After successfully completing firing tests in Europe in 2018, the TULPAR Light Tank began testing by two different users. What are your comments on the tests conducted with the TULPAR Light Tank since then and the ongoing marketing/promotion activities?**

**Serdar GÖRGÜÇ:** The TULPAR Light Tank's performance in the tests and the feedback from potential users are quite satisfactory. As you may know, the vehicle demands and the procurement process to be followed in the Defense Industry may often extend over quite long periods. We continue our endeavors.

*URAL Special Operation Vehicle*

**Defence Turkey: Otokar has been delivering the RABDAN Armored Combat Vehicle in 8x8 configuration to the UAE Armed Forces under the contract signed in March 2017 valued at US$ 661 million (approximately 2 billion UAE dirham). Could you inform us on the recent status of the project and the number of delivered vehicles thus far and their configurations?**

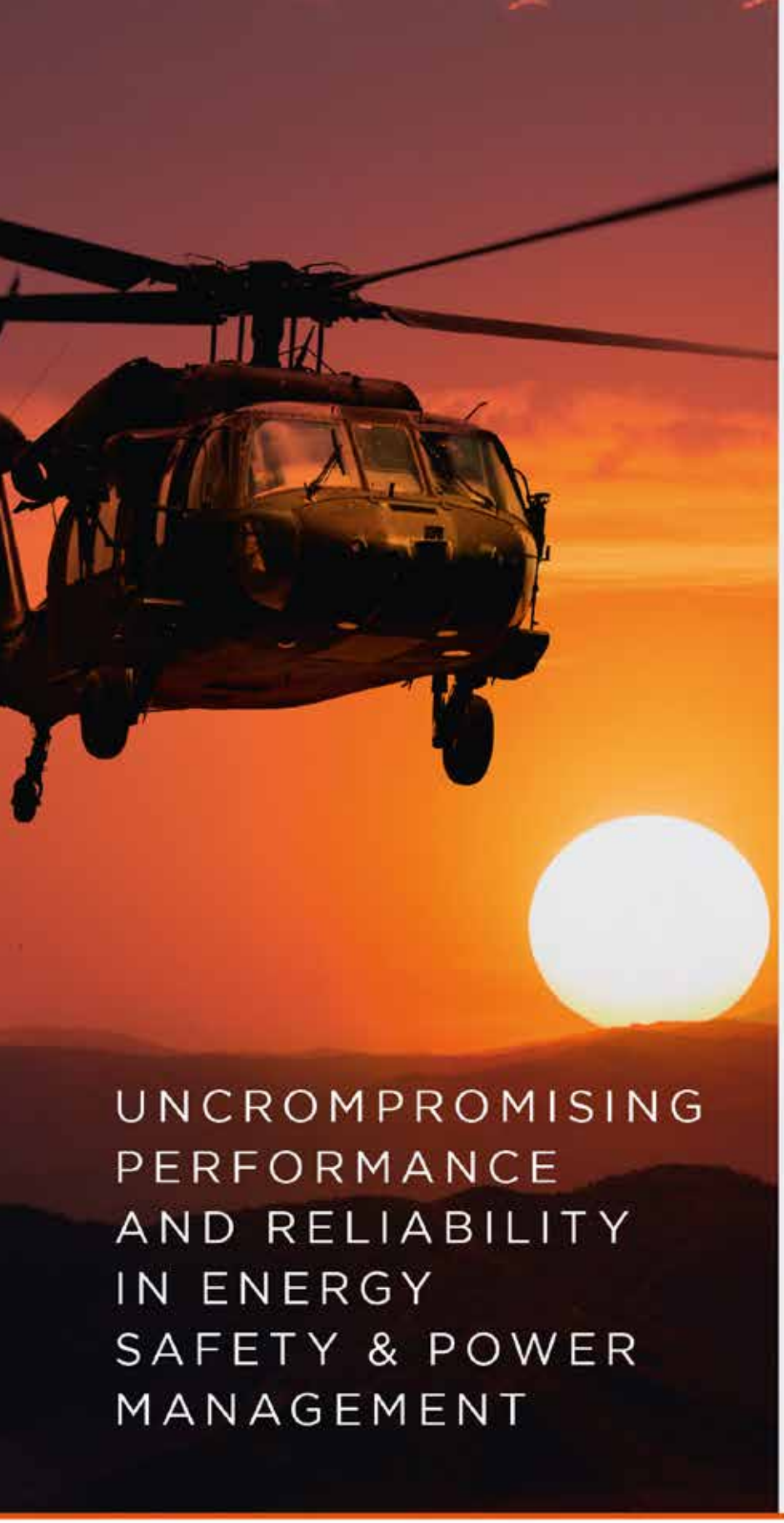
**Serdar GÖRGÜÇ:** The Project has been progressing successfully in line with the contract conditions since it began. We are unable to share any detailed information due to confidentiality reasons.

*AKREP-IIe was debut at IDEF'19*

**Defence Turkey: Otokar aimed to strengthen its international cooperation, particularly with the Gulf Region, to open new markets and increase sales with the Otokar Land Systems Company established in the UAE in 2016. Could you evaluate Otokar Land Systems Company's activities in the region during the last 4-year period?**

**Serdar GÖRGÜÇ:** Otokar Land Systems Company has truly been a major breakthrough for us in terms of location and being closer to our existing and potential users. We aim to strengthen our international cooperation mostly with the Gulf Region, to open new markets while increasing our sales. We are closely following the various cooperation opportunities in the region.

**Defence Turkey: Dear Mr. GÖRGÜÇ, I would like to thank you for your time and wish you much success**



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# With over 40 Years of Engineering Experience NUROL Makina is now in the Service of the Hungarian Armed Forces

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by İbrahim SÜNNETÇİ

Armored vehicles became one of the indispensable requirements of not only Armed Forces but also of Security Forces due to terrorist attacks that showed an increase across the world after September 11th and other asymmetrical risks and threats. Today, procurement programs for armored vehicles are executed for both the Armed Forces and Security Forces in many countries. These programs vary depending on the defense and internal security policies of countries.

Changes in operational requirements have necessitated the use of dynamic mechanized units more in recent years. The core employment of these units is based on mobility, agility, armored protection, firepower and logistic support. Counterterrorism operations, peacebuilding and peacekeeping operations that were conducted in the last 20 years have proven that the Tactical Wheeled Armored Vehicle (TWAV) is the most convenient vehicle for such missions.

TWAVs with high maneuver capability and armored protection, with advanced firepower and flexibility in usage, are in demand by Armed Forces and Security Forces across the world. These vehicles are 40% to 50% more cost-efficient than tracked armored vehicles considering their initial purchase cost and lifecycle costs.

As user requirements for armored land vehicles increase, they also then become diversified and configuration options increase as well. Since the parameters directing the design are identified by these requirements, new generation, robust and reliable TWAV platforms are being designed presently. These platforms will fulfill the combat requirements of Armed Forces while meeting the demands of Security Forces in maintaining security with high performance.

NUROL Makina, one of the very first privately owned companies of the Turkish Defense Industry, commenced its activities in 1976 and started to focus on the Defense Industry in the 1990s. The company initially worked on the production of sub-systems then finally on product development and brought a new vision to the industry with the indigenously designed, new generation EJDER YALÇIN TWAV platform with high performance that meets the expectations of the Turkish Armed Forces (TAF) and Security Forces (Gendarmerie General Command [JGnK/GGC] and the Turkish National Police [EGM]) in particular, and the military and security units of friendly and allied countries.

Launched into the service of the Turkish National Police (EGM) in 2014, the EJDER YALÇIN TWAV immediately turned its performance in the field into a commercial success and achieved considerable exports to foreign countries as a result of agile and pragmatic business development and marketing activities.

Having had its first export success with a contract signed with Tunisia in 2017, the EJDER YALÇIN Block-III 4x4 TWAV has been serving in five countries; such as Turkey, Tunisia (75+150), Uzbekistan (24 deliveries + planned local production of 1,000 vehicles), Qatar (342 vehicles, nearly 200 vehicles have been delivered as of April 2020) and Senegal (25 vehicles). Extending over years, the number of ordered EJDER YALÇIN Block-III 4x4 TWAVs for export as of April 2020 exceeded 800 (500 of which are firm orders) and if the ongoing project and contract negotiations turn into firm orders an additional order of over 1,000 vehicles may be achieved.

Developed to meet the operational requirements of Armed Forces and Security Forces, under all types of regional and land conditions including urban and rural areas, and offering high protection and mobility capabilities, EJDER YALÇIN is an indigenously designed platform that has proven itself in the operation field. With a recently signed contract the Hungarian

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EJDER YALÇIN BLOCK-I

Defense Forces became the most recent customer of the platform. In this way, NUROL Makina has become the first Turkish Defense Industry company to achieve success in the export of an indigenous combatant TWAV product, at a platform level, to a European Union (EU) and NATO Member country. One of our country's companies Otokar realized the export of the COBRA Chemical, Biological, Radiological and Nuclear (CBRN) Reconnaissance Vehicle to the Slovenian Armed Forces (18the Battalion of Chemical, Biological, Radiological and Nuclear Defense) in 2008.

NUROL Makina's indigenous products quickly rose to fame worldwide. Successful global products such as the EJDER YALÇIN TWAV and YÖRÜK NMS make us proud and without doubt this level of success has not been easy to achieve. Critical infrastructural investments were made, and significant R&D activities were conducted in to transform the company that had launched its activities in the industry with the production of sub-systems. The company now fulfills the demands of both the TAF and Security Forces and the requirements of foreign customers through designing and manufacturing its indigenous platforms and technologies without a foreign partner or without obtaining design support or license from a foreign company.

## Establishment and Entry into the Defense Industry

Founded in 1976 to operate in the Machine Manufacturing Industry, NUROL Makina is a company funded with 100% Turkish Capital. The Company decided to engage in the Defense Industry in 1992 and as a sub-contractor of its sister company FNSS, it focused on fields where FNSS had not been active, with the production of components in the first stage of operations. Activities began at the facilities in 1992 at Ankara's first Organized Industrial Zone in Sincan. The facilities used a 25mm Dragar one-person power-operated turret production for ACV-300 ACVs, Gunner's Cupolas for APCs (12.7mm Machine Gun Cupolas) and vehicle hatches. Over the years additional armor solutions and vehicle NBC systems were introduced, and in due course NUROL Makina became the source of all types of steel armor solutions for FNSS.

NUROL Makina gradually extended and deepened its range of activities in the Defense Industry, initially focusing on manufacturing components, then moved onto sub-system and main sub-system production and later engaged in the design and production of main systems. Directing its focus on the production of Tactical Wheeled Armored Vehicles (TWAV) to meet the developing needs of theTuAF, by cooperating with Ratmil Company (RomTechnica) located in Romania, NUROL Makina manufactured the TWAV solution in 6x6 configuration named RN-94 in 1994. In line with the contract signed with the MoND (Ministry of National Defense)/SSM (former Presidency of Defense Industries), five RN-94 TWAVs were ordered to be used for test purposes and the first vehicle was delivered in 1997 and the remaining four were delivered in 1998-1999 to the Undersecretariat for Defense Industries (SSM) of the time in order to be employed by the troops of the Land Forces Command (KKK). While no additional orders were placed for the RN-94, nevertheless it was NUROL Makina's first end-product experience. Though it signed a Production License Contract in 2003 for the Pandur-II TWAV Group of Steyr Company, NUROL Makina preferred to develop the 6x6 TWAV Group to be designed indigenously and manufactured locally. NUROL Makina also financed the development activities for the EJDER TWAV Group with an indigenous design and local production through its own resources.



*NUROL Makina's EJDER YALÇIN TWAV Configurations*

# The Emergence of the EJDER TWAV Group and the EJDER YALÇIN 4x4

EJDER YALÇIN BLOCK-II

Defense industry technologies mostly require critical and high cost R&D activities with confidential content and the export/import activities of the industry are subject to control. Technology transfer and product sale in the defense industry are affected particularly by the political relations between the countries. In order to alleviate such restrictions to the maximum extent and in interest of the country's target of achieving an 'independent defense industry', NUROL Makina decided to work on indigenous, domestic development activities. Following this decision, based on the idea that the TuAF would be requiring mine resistant vehicles, it launched a development project for a new and indigenous mine resistant 6x6 TWAV in 2006 completely through its own resources. The first member of the EJDER TWAV Group, the EJDER 6x6 Armored Personnel Carrier (APC) was revealed after a short period of 2 years including challenging and intensive R&D activities and all the tests. During the design and integration processes of the EJDER 6x6 APC Vehicle, CAN Bus design and implementation were also realized in our country for the first time through domestic resources and thus new technology was acquired. On account of the CAN Bus system, major conveniences were achieved in the integration of different systems (engine, gearbox, brakes, gear shift, ABS, axle beams, lighting system, accelerator, doors, etc.) in terms of central command control. The EJDER 6x6 APC was launched on February 3, 2009 and the Ministry of Internal Affairs of Georgia became the first customer of the product by placing an order for 72 vehicles. With this export activity, NUROL Makina made its mark with Turkey's first export of the 6x6 TWAV as well.

As one of the Turkish Defense Industry's oldest private sector players, especially with the company's new management and new approach, NUROL Makina has completely focused activities on its own unique products and systems since 2012 – the year when the company decided on developing its own 4x4 platforms. Within this scope, the prototype activities of the EJDER TWAV in 4x4 configuration, today known as the EJDER YALÇIN, were launched in November 2012 and the first pre-prototype was unveiled during the IDEF'13 Fair. A series of improvement and development activities were conducted on the prototype vehicle upon received feedback and production under the name EJDER YALÇIN Block-I was launched in 2014. The serial production of the first group of 5 vehicles was completed (US$ 8 million contract covering the delivery of total 11 EJDER YALÇINs with SARP – the Stabilized Advanced Remote Weapon Platform) and they entered into the inventory of the Turkish National Police's Department of Special Operations.

The renewed and further improved vehicle was delivered to the end user in 2016 with the name EJDER YALÇIN Block-II. Aselsan's SARP-II RCWS (Remote-Controlled Weapon Station) was used in the EJDER YALÇIN Block-II platforms and NUROL Makina delivered 70 vehicles of Block-I and Block-II versions to the EGM in line with the previously signed contracts. In 2016, NUROL Makina developed the Block-III platform which is the third version of the EJDER YALÇIN TWAV and launched its serial production. Within the scope of the Armored Tactical Vehicle (ATV-I) Project conducted by the SSM, former Presidency of Defense Industries, the first delivery was made on November 9, 2016 to the EGM which had placed an order of 180 vehicles. The launch of the EJDER YALÇIN Block-III was made during the 3rd High-Tech Port Fair. All EJDER YALÇIN Block-III TWAVs for the EGM featured Aselsan's SARP-II RCWS (7.62mm weapon).

Power packs of 300hp and 350hp capacities were used in the earlier versions [Block-I and Block-II] where a power pack with a capacity of 375hp was used in Block-III. Moreover, the internal volume of the vehicle was slightly increased while its mobility features were improved further (road-holding capability was improved). Certain additional operational features were added in line with the demand of the Special Operations Department of the EGM. Within this

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framework, for instance two cutters were placed on the vehicle roof for cutting of the steel sheets when the SARP RCWS over the vehicle is damaged or deactivated during operations in the residential areas. A fire extinguishing system was installed on the body of vehicle extinguish and prevent fires that may occur as a result of Molotov attacks (a similar solution is used in anti-riot vehicles as well). The previous versions of the vehicle contained fire extinguishing systems only for engines, wheels and cabins of the vehicle. The fire extinguishers in the personnel and engine compartments are automatically activated while the fire extinguishers in other compartments can be manually activated by the user.

The EJDER YALÇIN Block-III TWAV has the highest survivability capacity in its category (protection level of the vehicle was tested and certified by international independent bodies and by the TNO) and depending on its weight (the combat weight is 18 tonnes the vehicle offers extremely high mobility performance to its users. Thanks to the diesel power pack with high torque capability of 375hp capacity and fully independent suspension system, the vehicle offers superior performance in all types of fields conditions. Tested in 3 continents and 10 countries so far as part of the agile and pragmatic business development and marketing activities conducted by the Business Development Department of NUROL Makina, EJDER YALÇIN 4x4 Block-III TWAV passed quite challenging tests in countries such as Uzbekistan, Slovakia, Hungary, Qatar and Saudi Arabia and has proven its performance under difficult conditions and against competitors. Performing in various geographic conditions, fields and cities in Turkey since 2014, Ejder YALÇIN 4x4 TVAW accumulated millions of kilometers and displayed its capabilities in deserts, snow and ice, muddy fields, and moors with specially designed tracks in various geographies of the world from the Sahara Desert to the steppes and mountains of Central Asia. The EJDER YALÇIN 4x4 TWAV has not failed in any of the tests so far, on the contrary, the vehicle completed all tests successfully. By performing its duties in different conflict zones in certain countries that feature the vehicle in their inventory, the EJDER YALÇIN 4x4 TWAV has proven itself in the battle field while drawing the attention of potential foreign customers with its performance in mobility and resistance tests executed in the field, and it continuously attracts new opportunities for export activities.

*Armored Ambulance Configuration of EJDER YALÇIN TWAV*

During the development of the EJDER YALÇIN 4x4 TWAV, operational and ergonomic requirements of the user were taken into consideration in addition to the superior survivability capabilities and therefore an ideal platform was built for the safe and effective performance of personnel.

Depending on its ballistic protection features, the EJDER YALÇIN 4x4 TWAV has a payload capacity of up to 4 tons and the vehicle offers customized solutions to the various operational requirements of the user. It is able to perform as a Border Monitoring and Security Vehicle, Reconnaissance Vehicle, Tactical Missile Carrier/ Launcher, Command – Control Vehicle, Air Defense Vehicle, Combat Vehicle, Personnel Carrier Vehicle, CBRN Reconnaissance Vehicle, Mine/IED Detection – Destruction Vehicle or an Armored Ambulance. Due to its high payload capacity and unique vehicle control software, the vehicle can be configured in different versions and therefore it can be customized for various types of application.

## NUROL Makina: Tips for Transforming from a Sub-System Manufacturer into a Company Capable of Designing and Producing its Indigenous Platforms and Technologies!

NUROL Makina presently carries out the production of 4x4 Tactical Wheeled Armored Vehicles at its modern facilities that span across an outdoor area of 65,000m2 and an indoor area of 25,000m2 in Ankara. NUROL Makina has been conducting successful design and development activities in the TWAV sector for 28 years. The projects accomplished in previous

years further increased their experience and know-how. The company accumulated system/sub-system-based design, integration and manufacturing capabilities during the execution of projects for sub-systems of vehicles and system solution projects that require custom design.

Beginning its activities in the sector with sub-system manufacturing, critical investments were made to transform NUROL Makina into a company that would be capable of fulfilling the demands of the Armed Forces and Security Forces, capable of designing and producing its own indigenous platforms and technologies without a foreign partner or the support or license of a foreign company. In this way NUROL Makina now owns a state-of-the-art technological infrastructure including 5-axis laser cutters, 7-axis robotic welding machines, hydraulic eccentric presses, heat treatment, laser scanning measurement system and painting units, and has a high production capacity. Despite the COVID-19 pandemic, NUROL Makina has been carrying out its production activities in two shifts to fulfill domestic and foreign orders. Furthermore, upon special permits activities are executed even during countrywide lockdown days. With the help of its indigenous designs, NUROL Makina creates a difference in the land platforms segment and at the same time the company owns a modern test zone. The company executes


performance tests on its indigenously designed and manufactured vehicles in trench crossing and obstacle climbing, side and steep slope climbing, crossing rough terrain and deep fording.

Offering high-quality products to the defense industry with its machines, tests, computer-aided design and production infrastructure and engineering know-how, NUROL Makina registered its R&D Center in 2015 and improved and enriched its engineering staff in accordance with the requirements of the sector. The company also places great importance on the qualification of the products it designs and develops in compliance with international quality and military standards. In addition to the activities conducted for the development of its existing product portfolio and its focus on quality improvement, the company carries out continuous development activities.

The after-sales support provided to customers throughout the lifecycle of the systems and the company's elaborative approach to client feedback has strengthened the ties between the users and NUROL Makina. The result is reflected in customer satisfaction and reliability, and this ultimately propelled the company into a brand in great demand in the defense industry.

## The First EU and NATO Member Customer: Hungarian Defense Forces

NUROL Makina continued to increase its domestic sales particularly to the Turkish Armed Forces (TuAF) and to the Turkish National Police (EGM) as well as its foreign sales and the company signed a contract with Hungary in the second half of 2019. The company competed with TWAV products of leading European and US manufacturers and managed to become the successful supplier with its performance in the tests.

Hungary has been carrying out activities in order to increase the technological facilities of its Armed Forces and replace the older generation vehicles and equipment remaining from the Soviet Union era with Western systems and preferred to employ the EJDER YALÇIN TWAV as part of its requirement for a new generation TWAV in different configurations. With this order, Hungary became the 6th country in the world that has chosen


*Hungarian Armed Forces EJDER YALÇIN BLOCK-III TWAV*

*Qatar Army's EJDER YALÇIN 4x4 are seen on National Army Day of Qatar, 2019*

EJDER YALÇIN to fulfill the demands of its Army and Security Forces. Hungary was also the first EU Member customer of the vehicle. With the YÖRÜK TWAV order, also within the package, Hungary followed Qatar and became the 2nd international customer of this vehicle.

The agreement signed between NUROL Makina and Hungary's procurement authorities for a few hundred vehicles (EJDER YALÇIN and YÖRÜK) extends over years. The initial deliveries are expected to take place in 2020.

Within the scope of the Hungary project that will contain intensive engineering activities, various European manufacturers' (Aselsan may be on of them) equipment will be integrated in line with the specifications identified by the users for the vehicles to be delivered. Since the system engineering activities will be conducted over the EJDER YALÇIN and YÖRÜK TWAVs that will perform jointly with the various land platforms according to requirements in the inventory of Hungarian Defense Forces, the aforementioned vehicles will be in a different design and configuration from other versions that had been manufactured so far, in terms of the equipment to be installed over them. By exporting EJDER YALÇIN and YÖRÜK TWAV, NUROL Makina has in fact been creating new export opportunities also for other Turkish Defense Industry companies. To this end, for instance a new contract on the procurement of the SARP RCWS and SEDA Gunshot Identification System was signed between Aselsan and NUROL Makina in the beginning of April, probably to be used in the vehicles to be included in the inventory of Hungarian Defense Forces. Products of different companies will be available on some of the vehicles to be delivered to the Hungarian Defense Forces. Regarding the delivery of the equipment such as the SARP RCWS, KORNET-E ATGM Launcher System and the IGLA SAM Launcher System to be utilized in the EJDER YALÇIN Block-III and YÖRÜK/NMS TWAVs that will be delivered to Qatar, Aselsan previously signed a contract with NUROL Makina that amounted to approximately US$150 million.

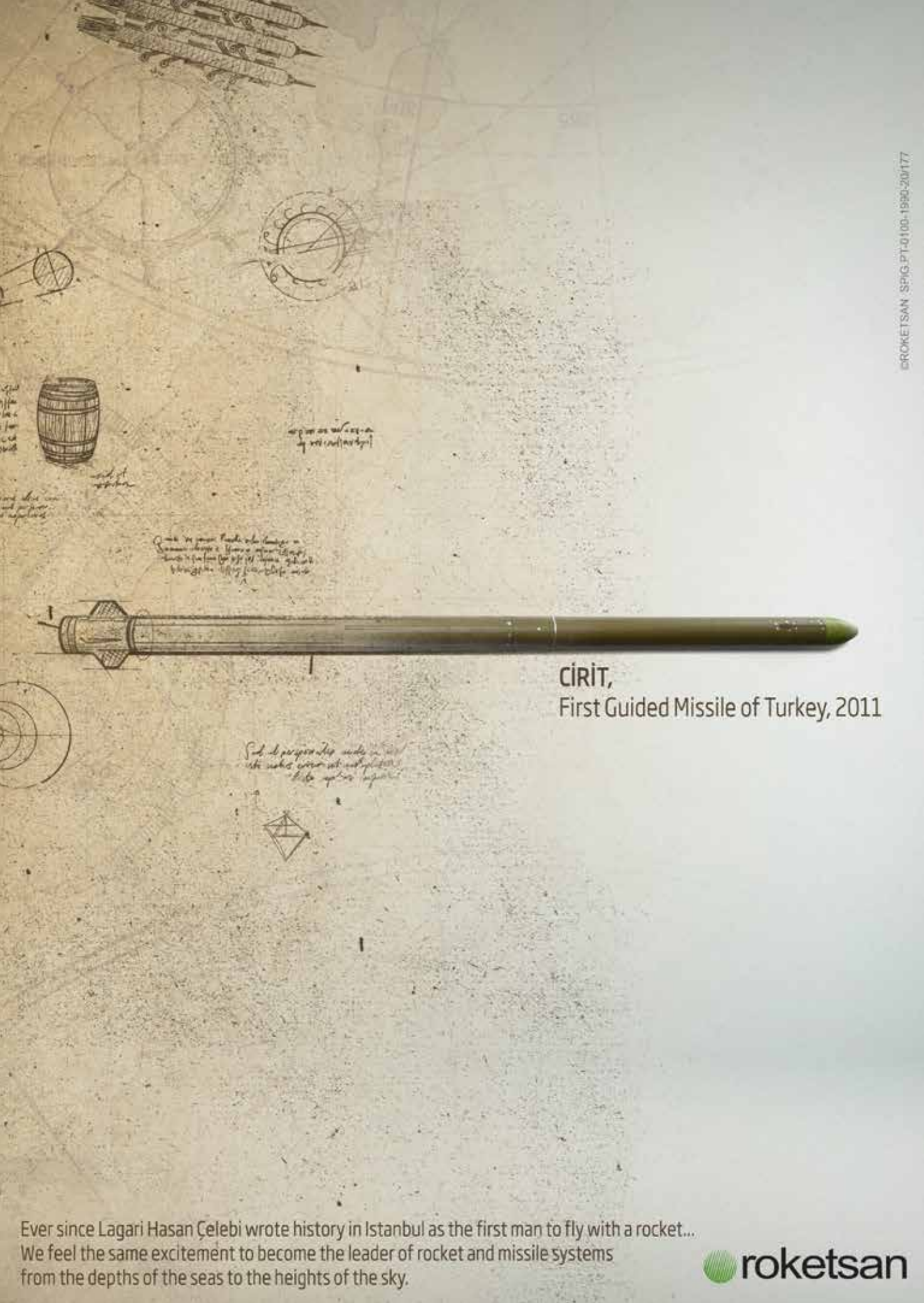
Training programs will be organized as part of the Project both in Turkey and Hungary for the staff of the Hungarian Defense Forces who will be serving in these vehicles. A long-term solution that will allow the foundation of a permanent footstep in Hungary may be expected. Since the order consists of hundreds of vehicles, NUROL Makina's permanent existence in Hungary in respect to the repair and maintenance of these vehicles would not be surprising at all.

NUROL Makina participated to the field tests organized by Slovakia in Europe with its product EJDER YALÇIN Block-III 4x4 TWAV and demonstrated one of its most successful performances by competing with its competitors in the tests, in which 10 vehicles from different segments and various countries took part.

## Conclusion

NUROL Makina continues its innovative activities in the defense industry by blending them with seasoned engineering experience of over 40 years. Presently, the company is further strengthening its position in the industry with its indigenous armored vehicle platform solutions such as the EJDER YALÇIN 4x4 TWAV, YÖRÜK/NMS 4x4 TWAV, EJDER TOMA 4x4 Riot Control Vehicle, EJDER KUNTER 4x4/6x4 and 6x6 Special Purpose Platform and the ILGAZ-I/II 4x4 Internal Security Vehicle.

In terms of its structure, technology and quality, NUROL Makina functions as a competitive company, advancing with firm and reliable steps towards a safe future. As a 'Solution Partner', within the scope of its target to become a more effective player in land platforms, it also aims to turn the EJDER, YÖRÜK/NMS and ILGAZ names into global brands as these products already have reached a certain maturity level and exports are increasing every year



CİRİT,
First Guided Missile of Turkey, 2011

Ever since Lagari Hasan Çelebi wrote history in Istanbul as the first man to fly with a rocket...
We feel the same excitement to become the leader of rocket and missile systems
from the depths of the seas to the heights of the sky.

roketsan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# "HAVELSAN Diyalog" new Secure Video Conferencing System

As protective easures have been adopted across the world due to the Novel Type Coronavirus pandemic, in this exclusive interview we discuss the measures HAVELSAN has implemented and the impact on production processes, and productivity with these new working arrangements, the defense industry's critical technology support to the healthcare sector, new business opportunities, cyber security, artificial intelligence, big data, autonomous vehicles and more with HAVELSAN's CEO & General Manager Ahmet Hamdi ATALAY.

**Defence Turkey: The COVID-19 pandemic has caused quite radical changes in business as well as in our daily lives. Naturally, all sectors are affected from this situation and it's no surprise to see that a significant amount of investment is being made now in the healthcare sector. Could you please inform us on the measures that HAVELSAN has implemented in response to the COVID-19 pandemic, your activities, and ongoing applications?**

**Ahmet Hamdi ATALAY:** HAVELSAN is one of the first companies that took action in this area. We have a well-functioning occupational health and safety council. In addition to our colleagues in this council, we have a healthcare unit, a doctor and a psychologist. This unit and the occupational health and safety unit are in close collaboration; they have been assessing the situation and submitting reports to me and the executive committee since the beginning of this period. Nearly four weeks ago, our executive board came up with the idea that we needed to adopt certain actions that would have a direct impact on our daily lives. Fortunately, no cases have been reported so far, but our employees were getting worried due to the developments they heard in the press and in their social environments. So, we examined the issue very seriously and held a comprehensive executive board meeting that lasted for a few hours with the participation of all our executives. For the first time, during that week we had a break. We let all our employees - except our employees and executives who had to fulfill urgent tasks regarding our commitments to our customers or our responsibilities towards our government or those who had to work on various administrative processes – take a leave for a week. This was 4 weeks ago and during that break, nearly 30% of our employees were at the facilities to perform urgent tasks. The remaining 65% to 70% were subject to leave. We conducted both our urgent business and made plans for the aftermath with the 30% on site in the office; actually, we executed quite comprehensive activities. Some of these activities were technical and others were organizational. We

conducted activities regarding hygiene measures or measures in a broad sense to be adopted against the pandemic and revealed a plan which we have been implementing ever since.

Currently, 90% of our employees are actively working but only 30% of them are coming to the office. All the executives of HAVELSAN, including me, remain at the office; some come to the office in shifts. We implemented a special method for the remaining staff, and this includes people with chronic diseases among them, they are all considered to be on administrative leave in public institutions. So, we advised them to work from home. Also, there are employees who do not need to come into the office due to the nature of their work, and for this we established an infrastructure for tasks that could be fulfilled remotely from home. We used this technology to enable our employees who did not need to be on site at the office, allowing them to work from home in a safer environment. Our remote employees are certainly a considerable number. The remaining part of our employees were those working at customer sites and we decreased their numbers as well. As I mentioned earlier, 30% of our employees worked on-site at the office and in order to keep the number of on-site employees at a minimum, nearly 10% of the remaining group takes leaves in turns. These colleagues do not come to the office, and they do not work from home either, but a method to compensate this time is also being applied. HAVELSAN is 90% remote now, and working from home with this structure, organization and technological infrastructure that we built.

**Defence Turkey: Have there been any changes in HAVELSAN's action plan for 2020 due to the unprecedented conditions caused by the COVID-19 pandemic?**

**Ahmet Hamdi ATALAY:** No, not yet. We are trying to measure the conditions in the interim. There is a critical technological infrastructure as well and we conducted quite crucial technological activities in the last four weeks. First of all, we focused on remote working. We built a technological infrastructure for the assignment of tasks within organizational scope and to measure performance and the quality of execution of these tasks while working remotely. In this way, we are also capable of measuring whether a colleague is more efficient when at home or in the office. The preliminary data reveals that working from home seems more effective than working in the office. If so, we are already 90% operational and if our efficiency increased by 10% compared to our performance before the crisis, then it means on account of this model we are actually capable of conducting our business in the previously planned manner. Therefore, we have not made any changes in our plans so far and we will make decisions about future steps as the air clears.

**Defence Turkey: You recently delivered the Combat Management and Command Control Systems of the Hızır Reis Submarine to Gölcük Shipyard Command during the pandemic, despite the recent slowdown. What would you like to say on how the new contract and delivery processes are being managed during the pandemic?**

**Ahmet Hamdi ATALAY:** Actually, the activities are proceeding as planned. We completed the Submarine Combat Management System. Similarly, there is an Airbus Pilot Training Simulator we developed for Turkish Airlines and we will be delivering that soon. Our production, projects and new contracts continue. We noticed that we used to hold a lot of meetings in the past and now we are holding these meetings via video conferencing. Thus, we are able to gather regardless of the physical location and time. In addition, we are also developing an indigenous version of the video conferencing system. We have been using the beta version of our own video conference system and we are offering this system to certain organizations in the meantime. In fact, it is an open-source product. We accomplished certain additional processes over this open-source system for performance and security improvement and turned the system into a product in a very short period, nearly a week. This video conference system is not cloud based; it runs in our own facilities therefore the data is not stored elsewhere. You also do not need to install any program as it is a web-based system. In this way, we are utilizing the infrastructure we built to fulfill both our requirements and to meet the telecommuting demands of other organizations or individuals, it's a product package and we will also be offering it as a service in commercial sense. It is a package that contains

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many capabilities (file sharing, data sharing and performance measurement, etc.) and it includes various tools as well. Hereby, we are sharing this development for the first time with your magazine. Currently, we refer to this product as the Telecommuting Platform, however we have not given it a commercial name yet. (HAVELSAN's video conference system is called "HAVELSAN Diyalog" was launched commercially on all platforms in May.)

**Defence Turkey: HAVELSAN is at the same time a company with companies and offices in Oman, Qatar, Kuwait, Malaysia and Pakistan. Are there any disruptions or delays in the projects and activities you are executing at these companies and offices abroad due to the unprecedented environment created by COVID-19?**

**Ahmet Hamdi ATALAY:** We have offices and actively working employees in those countries, and we are following up potential business opportunities in the Asia-Pacific region. We also have projects that are being executed in Africa and in many countries across the world. Naturally, all these countries are affected by this pandemic. We are not able to go there and people living there are unable to come here. We are not able to ship any materials, equipment, etc. Therefore, naturally a delay occurs. Although there is a delay in terms of time, none of our business opportunities there has been lost. We fear losing our business to our competitors more than due to postponements. Yet, there is currently no such threat, presently business is suspended, and we endeavor to turn this into an advantage. On this opportunity, I have to underline that certain products required for the fight against the COVID-19 pandemic started to create business opportunities for us. We imported a thermal camera in this period and by adding certain software to it we launched it into service at our facilities and also for use in security checks of many ministries, public institutions and for instance at Ankara City Hospital's entrance. At the same time, we are working on exporting diagnosis kits with USHAŞ Company, certified by the Ministry of Health.

**Defence Turkey: Like all other areas, exports were affected negatively by the COVID-19 pandemic and trade took a major blow on global scale. According to the data provided by the Turkish Exporters' Assembly (TIM), a decrease by 49.8% was observed in the exports of the Turkish Defense and Aerospace/ Aviation Industry in March, compared to the same period the previous year. Could you please compare HAVELSAN's export performance in the past three months with the figures achieved in the previous year? Considering the fact that potential markets/ customers are also affected by the COVID-19 pandemic, will export targets/figures be revised for 2020?**

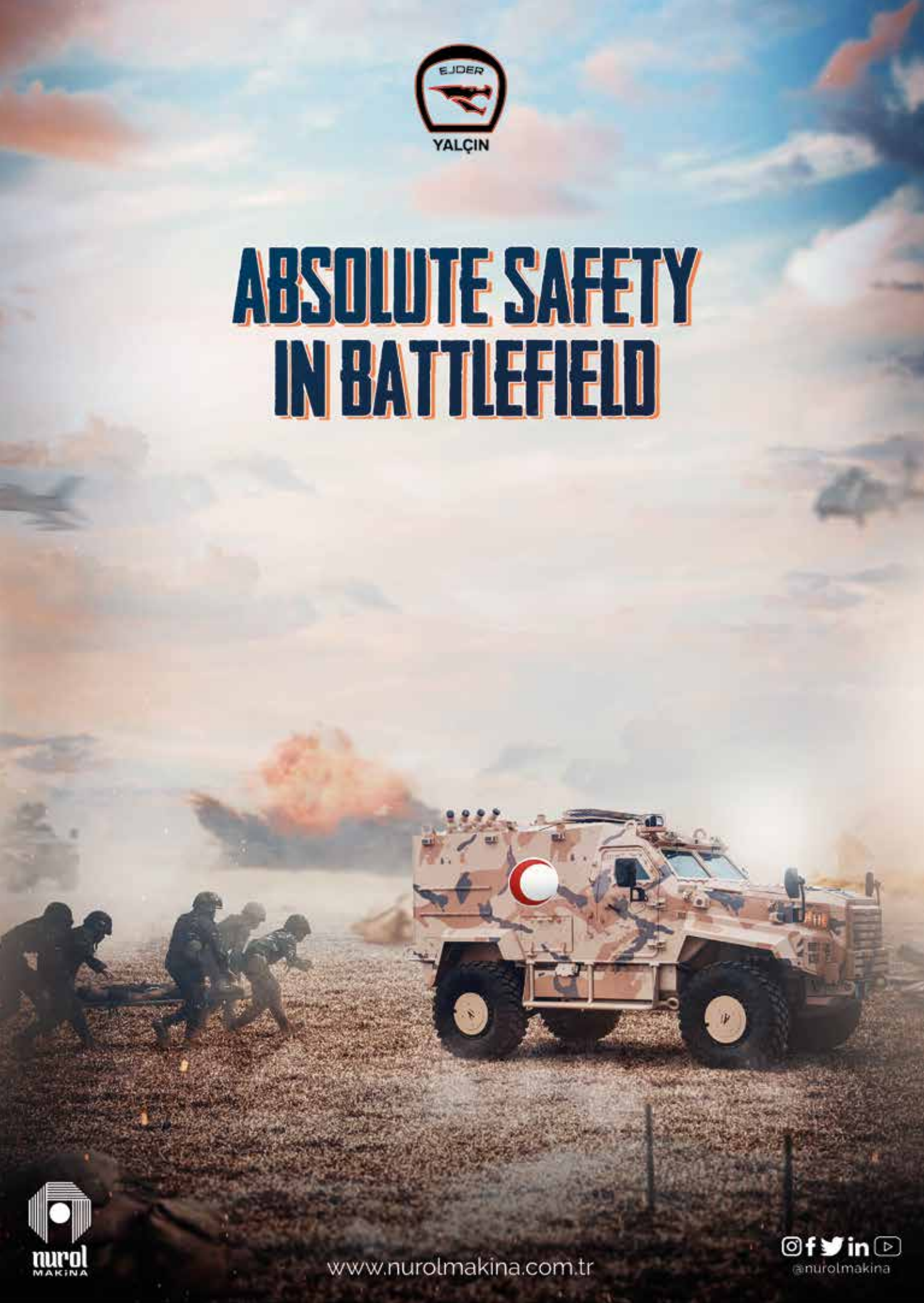
**Ahmet Hamdi ATALAY:** The priorities of countries have changed in this period. Presently, nobody is talking about the F-35 program; instead we are discussing the production of ventilators/respiratory devices. So, the agenda as well as requirements of countries have changed. Then again, this does not mean that our previous projects were left aside; perhaps they may only be postponed. Therefore, we do not perceive this situation to be a major threat or a risk. This why we have not yet revised our plans, but we are anticipating certain delays and changes.

**Defence Turkey: E-Commerce activities in our country have seen a significant increase due to the COVID-19 outbreak. Therefore, IT infrastructure and cyber security have become one of the most critical aspects of this transformation. What type of efforts in cyber security has HAVELSAN been conducting as Turkey's center of excellence in cyber security during these times that have also triggered a spike in cyber-attacks? What solutions have you been providing organizations in our country on how to strengthen and support their existing information infrastructure?**

**Ahmet Hamdi ATALAY:** We provide various services to our customers regarding cyber security. One of them is the security maintained by our teams at the customer site. We have security experts in certain public institutions, and they are actively providing the security of

EJDER YALÇIN

# ABSOLUTE SAFETY IN BATTLEFIELD



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HAVELSAN SİSATEM

that institution. On the other hand, there are 100% indigenous and national products that we develop, and we are providing services to our customers with these products as well. Our third service is related to areas that we do not have any products, but we offer a cyber security package composed domestic or foreign products existing on the market. Moreover, we began providing training for general online public emphasizing the social responsibility dimension of our business, particularly in the recent period. The courses we designed are focused on increasing awareness in cyber security. We wish to create social awareness so that with this awareness, the public and especially our youngsters will be able to improve themselves to meet competency requirements in this area. This was among the areas that I suggested initially when the "stay home stay safe" period appeared on the agenda. Our young people could train themselves in cyber security during the time they were at home; presumably nearly 3 million cyber security experts are in demand across the world. Turkey needs around 30,000 experts in this area, and this creates a job opportunity for our youth. We complain about the high level of youth unemployment, this is not because there are no job opportunities. Unemployment is due to the lack of required capabilities. This why we tell them to improve their qualifications and train themselves in cyber security. Artificial Intelligence (AI) is another popular topic as AI is becoming more involved in our daily lives. Surely, one must improve their software expertise to be capable of collaborating in all these areas. Graduating from the Computer Engineering department is not essential to become a software developer; there are many successful software developers who have degrees from different branches. Therefore, one is completely capable of becoming a successful software developer independent from the branch they studied. And now, all the training material required for this is at your fingertips via the internet, so this truly is a great opportunity.

There are three critical components when we are speaking of cyber security: Human beings, technology and processes, the weakest link in this chain are human beings. One cannot solve this problem merely through technology or systems without strengthening this link (executives, employees, experts, etc.) in the chain. Both a shortage of experts and a lack of awareness exists in the human dimension of the chain in addition to apathy. HAVELSAN is helpless to do anything if the awareness of our people is not sufficient in this area, one can only go so far with technological facilities and capabilities.

**Defence Turkey: Our defense industry companies have been providing great support to the healthcare system during this period. How has your Company's software and system solutions in information technologies been utilized in healthcare within the scope of the measures against COVID-19? And how could they be utilized in the future? For instance, has HAVELSAN's ATLASCARE Health Management Information System been launched in this period?**

**Ahmet Hamdi ATALAY:** We are an information technology company that develops software-intensive technologies. These technologies exist in all aspects of life and now they are being increasingly used in the healthcare sector. Once, the Republic of Turkey was the country that made the best information technologies in the banking sector. Nowadays the healthcare field is going through what the banking sector experienced before. This is irrespective of the pandemic period that we are living in. We are now at such a state that on account of the information technologies both diagnosis and treatment

and management systems are presently more effective, less costly and more qualified. Hence, information technologies are the most critical tool and infrastructure to maintain the best price, quality and performance in healthcare information systems of the hospitals. This fact is recently being realized by the whole world, yet Turkey has been well aware of it, and therefore information technologies are being rapidly adapted to the healthcare sector. The Hospital Information Management Systems that we refer as HIMS composes a critical part of this. A large amount of data on healthcare is being generated here; the data of 80 million people is being collected. This, at the same time is very valuable data, in a way data is the oil of our times. Now, if this data is correctly analyzed with the help of Artificial Intelligence, then the behavior/ pattern of many types of disease, their geographic or demographic context or periodic states could be observed. Naturally, HAVELSAN is the technology provider of this sector as an information technology company. HAVELSAN previously built the Military Healthcare Automation System (MHAS) as well. We modified this system and made it compatible with the city hospitals upon the demand of the Ministry of Health and added many new technologies such as Artificial Intelligence to support decision makers. For instance, the system intervenes when the doctor attempts to prescribe a rheumatism drug to a patient with high blood pressure. We call it the healthcare information management system but in fact it is way beyond that, its name in English is ATLASCARE and we call it ATLASÇARE ("çare" is a word for remedy/cure in Turkish). Our ATLASCARE system will be the CURE for the healthcare sector. We have hospitals of colossal sizes that do not exist anywhere else in the world and this system will play a key role in the management of these gigantic hospitals. Compatible software technologies or technological infrastructures are required for their management. Presently, two hospitals are using this system and it will become more widespread.


Software development does not merely involve coding. Software development can be compared to the process of putting up a wall; to construct a building the architect designs the building; the civil engineer makes the calculations and the mason builds the wall. The construction is revealed through the coalition of all these disciplines. It is similar in software development, there are many sub-disciplines. Therefore, in hospitals of such grand sizes, products that come out from a system involving all these disciplines are required for the management of healthcare information systems. There was a gap in this area in Turkey and we introduced a new product to fill this gap upon the direction of our Ministry of Health. We have placed several bids abroad and we aim to sell this product to foreign countries as well.

Other than that, we endeavor to develop other products to meet the needs of our times. For instance, we have a project for the management of people who interacted with our patients with positive COVID-19 test results. The Ministry of Health has a project in this area, and we are working on the technologies to render this project more effective. We are developing a solution that builds up the profile of anyone who has been in contact with our citizens with positive test results and shares them with decision makers by forming a network. This retrospective scanning is for the time being limited to the families of the patients and their colleagues at work, yet with the help of this system to be developed, the people they coincide with on public transportation or at supermarkets could also be identified. We have other projects in this area as well. Healthcare information technologies have become one of our main functions and from now on our activities in this area will be increasing.

**Defence Turkey: HAVELSAN is a major company experienced in critical areas such as Robotics and Autonomy, Big Data and Artificial Intelligence, Secure Mobile Communication and Augmented Reality. What are your comments on the latest status of the ongoing technology development activities in these areas?**

**Ahmet Hamdi ATALAY:** HAVELSAN has been conducting activities in these new technologies, referred to as 'disruptive technologies' by some, such as Artificial Intelligence, Autonomous Systems, Big Data Analysis, and Augmented and Virtual Reality. HAVELSAN really has a great opportunity here. Last year, we attended a NATO meeting in Germany and the topic of the meeting was disruptive technologies. While we were expecting to hear about newly developed weapons and bombs, instead they introduced

to us Artificial Intelligence, Big Data Analysis and Augmented Reality at the meeting. These areas we have been working on are also regarded as disruptive technologies by NATO. As HAVELSAN, we are active in all these areas. For instance, perhaps we may have one of the most powerful teams in Turkey in the field of Artificial Intelligence; around 50 of our experts are working on this subject. This team only focuses on Artificial Intelligence and develops algorithms in this area. Besides, nearly 2,000 of our employees are working on Artificial Intelligence and its derivatives and approximately 1,700-1,800 of them are computer engineers. Therefore, this is among our main areas of activity, and it provides input to the Healthcare Information Management System as well as our other products. Augmented/ Virtual Reality is another of our focus areas. We are establishing virtual reality platforms. There are two pioneer companies in the world in this area. One of them is interestingly a Turkish company located in Germany. They are working on game engines used in computer games. Surely, we have no interest in building game engines like them, instead, we are developing a more industrial model of that engine which could be employed by augmented reality/virtual reality and simulations and at the same time we are manufacturing a framework which the virtual reality applications will be developed over. Presently, all actors working on virtual reality are using a framework that is produced by one or two companies in the world. Universities also use them; they cannot break their habits once they get used to it. We are building our own indigenous and national framework, and we have made great progress. Hopefully, we will provide it to our universities free of charge and our children will be educated through its use. In this way, they would not be dependent on the products of multinational companies. We have technical and cooperation agreements with nearly 25 universities. Our team in Istanbul has been cooperating with Gebze Technical University in this area.

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Regarding autonomous systems, as you know we define software as intelligence included in existing or new systems. Certain functions are added to a semi-intelligent or "dumb" system and it becomes a smart system. This is the exact role of HAVELSAN, we add intelligence to systems, and we do it through software-based products. Automation can be achieved by enhancing products through intelligence. We also have a project on a self-driving car. Test drives on lane keeping are currently being conducted in Ankara on various highways. Our genuine intention is not achieving a driverless car, we are in fact focused on automation of Land, Naval, and Air platforms in the area of defense. We are working on autonomous and unmanned systems and technologies where autonomous systems can act as swarms. At this point, I would like to underline the concept "swarm". Most existing systems function independently, but the new concept is swarm intelligence, these systems function as a swarm and we are working on it. For instance, we have an armored land vehicle developed for CBRN (Chemical Biological Radiological Nuclear) threats. There are special units assigned for each of these subjects and our competent colleagues are working in these units

**Defence Turkey: Presently, within the scope of the Turkish Armed Forces' needs, HAVELSAN is actively taking part in many projects in Land, Naval and Air categories such as ADVENT SYS, SGRS, REIS Class Submarine Combat Management System (CYS), TCG Anadolu LHD, I-Class Frigate, BARBAROS MLU, PREVEZE MLU and MELTEM-III. Is a slowdown or delay in these projects anticipated due to the COVID-19 pandemic? Could you inform our readers on the measures you have adopted to minimize the effects of the COVID-19 pandemic and on your ongoing implementations and activities?**

**Ahmet Hamdi ATALAY:** The course of events so far indicates that no major delays will be expected. There may be delays of a few days or weeks, but we have not experienced any cases that would cause a postponement of months

or years in the projects. The only difference we observe compared to our past activities is that we are working without meeting face to face. The meetings are being conducted via teleconferences or video conferences. None of the projects have been suspended and there are no disruptions in any of our activities.

**Defence Turkey: Is there some good news to share in 2020 regarding the projects you have mentioned?**

**Ahmet Hamdi ATALAY:** It would not be proper to talk much on defense projects. Moreover, the Presidency of Defense Industries informs the public on these developments. I would once again like to underline that we do not foresee any delays in the planned projects. Then again, we may reveal several surprise products when the needs occur just like with the needs for telecommuting. Let me give an example, the public also has to be informed. There was a Thermal Camera crisis in the beginning of the COVID-19 pandemic. At that time, we were already working on the analysis of the images captured by such cameras with a company located in Germany owned by Turks for another project. Then, as the crisis emerged, we thought whether we could utilize these thermal cameras during this process. Once we decided that we could, we utilized these cameras initially for our own requirements then gave them to those who were already informed about this product in the Turkish Armed Forces and the Ministry of National Defense. I do not wish to tell the prices now, but cameras with similar capabilities are sold for prices three to four times higher than this one. We were unaware of the prices as this was not an area we were interested in. We installed these cameras to hundreds of public institutions at one fourth of their market price. In this way, we obtained a thermal camera capable of scanning body temperatures and we have been conducting software development activities regarding this. Therefore, we came up with different types of projects during new emerging conditions. Each period contains different opportunities and the actual skill here is to identify these opportunities and to realize them. I believe there is no need for pessimism. I will be repeating myself but HAVELSAN did not have any plans on telecommuting or working from home until a very short while ago. I probably would not have approved a project of such nature 6 months ago. And here we are, stating that perhaps a few years later HAVELSAN will be conducting a considerable part of its activities from home or maybe the staff we employ will be located in other cities. We are speaking of a brand-new and independent business model that is not limited by time and location. This requires a cultural change, and a new organizational structure and it alters the business infrastructure and requires secure and consistent technologies. Presently, we are in a sense conducting a proof-of-concept study, we are testing the products and the results have been positive so far. This may not be practical for companies that engage in active production, such as companies that need to operate on site at factories, but for us, our colleagues are capable of working from their computers at home via the secure connection we provide them.

**Defence Turkey: Since the defense industry is quite a critical sector, unfortunately many companies cannot operate irrespective of time and location, employees must actively work on site at their workplaces. Do you have any activities going on right now to provide this infrastructure to other defense industry companies?**

**Ahmet Hamdi ATALAY:** We are preparing a product package in this respect and we will offer it to willing parties and to organizations that require it. It is a package that contains many products; a video conference system and secure communication are included as well. We have a product called "Dialogue" and we are developing both the desktop and mobile version of it. We have a sharing platform called HVL-Drive to share large scale data and it will also be included in the aforementioned package. We have a tool for business management known as JIRA by the world and we are integrating it to this system as well. Once we install it to the related organization, it really does not matter where your physical location is. Therefore, this period of pandemic contains major opportunities for companies such as HAVELSAN, that focus on information and communication technologies.

**Defence Turkey: Would you like to convey any messages to our readers?**

**Ahmet Hamdi ATALAY:** We have implemented and are following isolation precautions and hygiene procedures quite effectively at HAVELSAN. We also have a comprehensive document titled as COVID-19 Action Plan in this regard. We prepared this document at the end of March and we have been sharing it with other organizations as well, because there is a need to share know-how in this respect. We are facing a pandemic that does not pay regard to religion, language, or race of the infected. All of humanity is experiencing an unprecedented crisis. The experts instruct the washing of hands, avoid touching the face after contacting a given surface, keeping the social distance of a few meters between people and avoid leaving home and avoid blending with crowds as much as possible. We need to abide by all these rules very strictly because by obeying the rules we are not only protecting ourselves; we are protecting others at the same time; we all have a responsibility to society and hereby I invite everyone to be more sensitive to these issues


# Aselsan Infrared Seeker Development Studies

Infrared seekers are missile subsystems that use the infrared (IR) light emission from a target and its background to detect and track it until the target is destroyed. Since the operational requirements (target/background, mission scenarios, etc.), environmental conditions (aerothermal effects, natural background radiation, in-flight vibration values, etc.), and design limitations (weight, power, activation time, etc.) of seekers are extremely challenging compared to other thermal imaging systems, system and subsystem level design processes must be carried out according to the specific missile applications.

## Infrared Seeker Technologies

Since the infrared seekers are located at the nose of the missile, they are highly exposed to the harsh conditions of the missile. Some of the factors that make infrared seeker design generally challenging are [1]:

- Very high acceleration and vibration levels due to high speeds and maneuvers,
- High-speed movements of the targets,
- Very short activation/arming time,
- Missile dome heating due to high speeds and maneuvers,

These challenging conditions and specifications require the use of very special techniques and technologies in infrared seeker design.

## Stabilization

During the flight, aerodynamic forces create angular vibration effects on the seeker. To eliminate the effects of these vibrations on the image, the seeker is stabilized using a gimballed structure with a gyroscope that measures inertial speeds.

In addition to the high angular vibrations on the seeker, other factors such as:

- High gimbal speed requirements due to the high speed of the missile and the target,
- Wide field-of-view (FoV) requirements,
- Volumetric limits of the missile,

also require a specialized gimbal design.

## Image Frequency and Image Blurring

Since both the missile and the target are extremely fast, the image acquisition frequency must be very high, and the rendering time must be very low. In order to acquire a clear image and prevent motion blur, the missiles should be equipped with thermal cameras with a higher image frequency rate than the infrared cameras used in land vehicles.

Since motion blur makes it almost impossible to detect and track targets, it significantly reduces lock-on range. High image frequency requires a high-performance infrared sensor, high processing power, and parallel processing capabilities.

## Short Seeker Activation Time

When the threat is detected, the missile should be ready to fire in a very short time. In addition to activating the missile's electronic equipment, one of the most crucial processes that take time before firing is the infrared sensor's ability to provide an image that meets the mission's performance requirements. The time required for this process differs according to the sensor specifications, as well as the use of cooled or uncooled infrared sensors. Sensor temperatures must be lowered to cryogenic levels for the cooled infrared sensors to detect a target. Accordingly, either Joule Thomson (JT) type or Stirling type cooling technologies are used in infrared seekers.

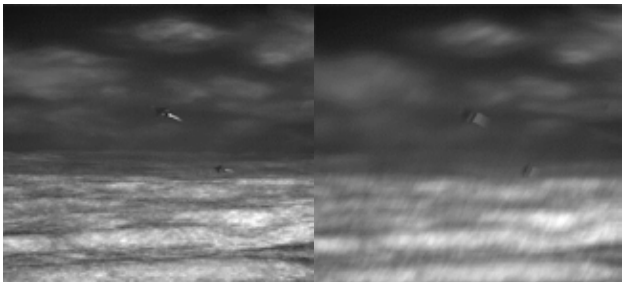

*Figure-1 Difference between stabilized (left) and blurred (right) image.*

## Dome Heating (Heat Flux) and Thermal Shock

The high speed of especially the air defense missiles can cause the missile dome to reach extreme temperatures in a very short time during the flight. The missile's high speed not only heats the seeker dome but also creates a hot air wall in front of the missile by compressing the air in front of it. The hot and compressed air also acts as an optical lens. This can be summarized as trying to see a target that is miles away from behind a very hot wall with a heat-sensitive sensor. These aerothermal conditions cause very high disruptive effects on the seeker, such as:

- Extreme noise and infrared radiation (IR) on the sensor,
- Loss of image clarity as a result of the change in the refractive indices of the dome and lenses,
- Rapid heating of the missile seeker components.

Aselsan carries out dome heating, radiation, and optical analysis studies during the development process of its infrared seekers as well as designs high-performance electro-optical parts using special components, methods, and technologies.

*Figure-2 The effects of dome heating on the image.*

Especially in air defense applications, dome heating (heat flux) requires the development of a special sensor that can withstand thermal shock and optical lens design that is not affected by temperature change.

## Seeker Algorithms

Depending on the mission requirements, the image processing capabilities of the infrared seeker can include target detection, target tracking, and countermeasure detection.

After the target is detected, the tracking algorithm is activated. The tracking algorithm follows the target by fusing both image and inertial data. Since tracking is accomplished using multiple target windows and motion models of these windows, it is both reliable and adaptable to different flight stages. A countermeasure detection algorithm is also run simultaneously to prevent deception during the tracking phase.

Within the scope of infrared seeker development, previously developed Software-in-the-Loop (SIL) and Hardware-in-the-Loop (HIL) systems are used within Aselsan MGEO for the development, parameter optimization, and testing of image processing algorithms. These systems are used to model the target, background, atmosphere, and hardware units. Thanks to the software-in-the-loop infrastructure, all algorithms can be developed in parallel without waiting for the hardware design to be finalized; also, the maturity level and performance of the software can be increased before the highly expensive real tests.

## Infrared Detector

One of the most critical sub-components that determine the infrared seeker performance is the capabilities of the infrared sensor used. Infrared sensors are used in various systems such as Forward-Looking Infrared (FLIR) cameras, PODs, Missile Seekers, and Tank Fire Control Systems to detect threats and increase mobility in adverse conditions such as night, fog, dust, and smoke where visibility is poor.

In missile applications where response time and sensitivity are highly vital, the infrared sensor's quality directly influences the missile seeker's performance.

The type of sensor to be used in the seeker is determined by the wavelength range at which the target will be detected, the response time needed, and the sensitivity of detection. Critical sensor parameters affecting seeker success are:

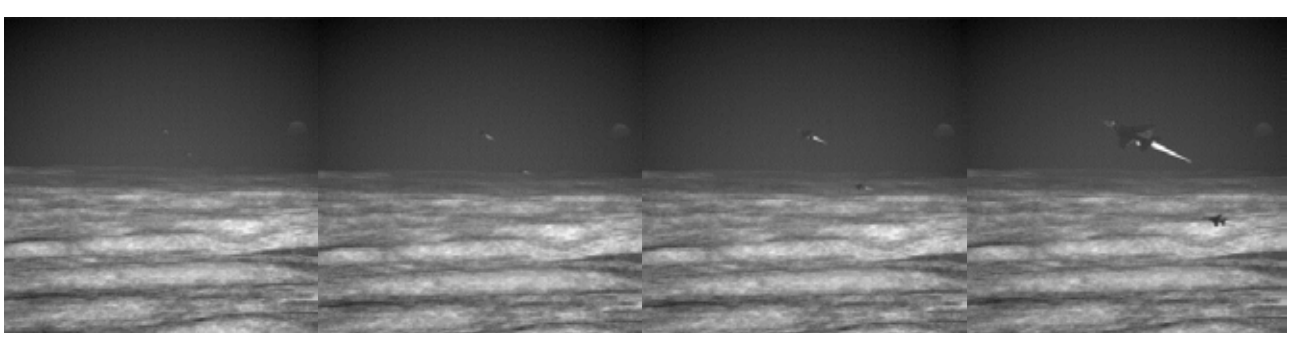

*Figure-3 Infrared seeker image of an air defense missile approaching the target.*

**Detection Wavelength:** When selecting the detection wavelength, it is necessary to prioritize the requirements, such as the signatures of the targets and the operating temperature of the sensor.

**Sensor Array Format:** The sensor array format is a parameter that directly affects the seeker detection range. Increasing the sensor array format, just like the pixel pitch and field-of-view, improves the detection range. On the other hand, the expanded sensor array format also increases the sensor area, increasing the optomechanical carrier volume to be placed inside the sensor and, consequently, its thermal mass. Optimum sensor array formats should be used according to the mission requirements to meet the system's activation time and range needs.

**Sensor Pixel Pitch:** As the sensor pixel pitch grows, the Signal/Noise ratio of the pixel also increases. Between two systems with the same resolution and field of view, the system with the larger sensor pixel pitch can detect targets at greater distances. However, since increasing the pixel pitch also increases the sensor area, this will also increase the volume and thermal mass of the optomechanical carrier. Therefore, it is necessary to use sensor arrays with optimum pixel pitch that will meet both the time and volume needs determined by the main system requirements and the maximum detection distance.

**Sensor Performance:** Infrared sensors to be used in missile seekers must have appropriate wavelength detection, resolution, and pixel pitch features and should also be able to meet very high-performance criteria. Important performance criteria for infrared detectors are:

**Quantum Efficiency:** Quantum Efficiency can be defined as the possibility of photons collected by the sensor to be converted into electrons. High quantum efficiency allows the sensor to be used at both high speeds and low background radiation.

**NETD (Noise Equivalent Temperature Difference):** NETD can be defined as the smallest temperature difference that the infrared sensor can detect. As the NETD value decreases, the performance of the sensor increases at the same rate.

**Reading Circuit:** The reading circuit, which will be integrated into the infrared sensor, should have features that can meet the main system reirements. The most important of these features are:

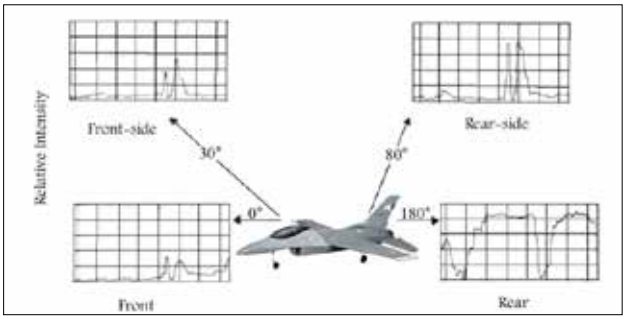


*Figure 4: Infrared signature spectrum of a fighter plane [2]*

**Image Speed:** The reading circuit and the sensor array to be integrated into the reading circuit should be able to support and operate at higher frame rates due to the high missile and target speeds.

Reading Circuit Load Capacity: The heating of the dome (heat flux) indicates that the infrared sensor is entirely exposed to emissions that do not contain any target information. If the reading circuit does not have enough load capacity to hide the radiation from the dome and reaches saturation, the emissions from the target will not be detected, and as a result, target detection and tracking will be impossible. Therefore, the reading circuit must have a very high load capacity, and non-standard techniques should be used in the entire circuit design to achieve this goal.

## Conclusion

Started with the production of the infrared seekers of the Stinger missiles and continued with the domestic and national development of infrared seekers of antitank weapons and air defense missiles, Aselsan acquired the skills, experience, and infrastructures in the field of seeker technologies that only a few countries have in the world.

The outputs of cutting-edge seeker development activities of Aselsan are also used in technologies and products developed in other fields such as electro-optics, microelectronics, and avionics

## GÖKTÜRK - 2

*EO SATELLITE SYSTEM*

## TF

*TURKISH FIGHTER*

## HÜRJET

*ADVANCED JET TRAINER AND LIGHT ATTACK AIRCRAFT*

## AKSUNGUR

*HIGH PAYLOAD CAPACITY UAV SYSTEM*

## HÜRKUŞ

*ADVANCED TRAINER AIRCRAFT*

## ANKA

*MULTIROLE UAV SYSTEM*

## GÖKBEY

*MULTIROLE UTILITY HELICOPTER*

## MULTIROLE HEAVY COMBAT HELICOPTER

## AIRBUS A400M

*MILITARY TRANSPORTATION AIRCRAFT*

- *Forward Center Fuselage*
- *Tailcone and Rear Fuselage Upper Panel*
- *Ailerons and Speed Brakes*
- *Paratroopers and Emergency Exit Doors*
- *Water and Waste Systems*
- *Fuselage Cable Hardware*

## T129 ATAK

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# Honeywell Turkey Delivering the Best Proven Engineering Solutions Worldwide

**In this insightful interview with Serdar ÇETİNGÜL, General Manager Central & Eastern Europe and Turkey, Honeywell Aerospace, we discuss Honeywell's integral role in bringing advanced capabilities to Turkey's native defense industry and the exciting future outlook in building the future of the aerospace industry together.**

**Defence Turkey: Just before the IDEF '19 Fair you were appointed as the General Manager of Central & Eastern Europe and Turkey for Honeywell Aerospace. Can you begin by telling us a bit about your new role and responsibilities?**

**Serdar ÇETİNGÜL:** Previously, I was Business Director for Turkey and Central Asia. With this new appointment I am now responsible for all aspects of the Aerospace Business, including airlines, business and general aviation and defense & space across 26 countries in Central and Eastern Europe and Turkey and Central Asia. In my new role, my top priority is to accelerate organic growth and find new opportunities for Honeywell Aerospace by ensuring our customers get the best possible and most efficient technologies to help bring value to their fleets and developmental programs.

Turkey is an important growth market for Honeywell and is a part of what we refer to as "High Growth Regions." It is a market in which I have a good deal of experience, across both public and private sectors. I also have background as an electrical engineer specializing in aerospace which gives me the ability to view things from both a solutions development and end-user perspectives. I am extremely proud to be able leverage this experience in order to fully understand customer requirements as we develop comprehensive solutions that offer enhanced value to our customers, especially in Turkey.

**Defence Turkey: Can you elaborate on the structure, responsibilities and number of personnel working at Honeywell Aerospace's Central & Eastern Europe and Turkey Branch that is based in Poland?**

**Serdar ÇETİNGÜL:** Though an American company, Honeywell Aerospace is truly a global operation. We have a very talented team that is located across the globe including product development, engineering, integrated supply chain, and customer support. I am leading all aerospace efforts for the CEE and Turkey and Central Asia regions.

**Defence Turkey: In your new position you are responsible for a broad geographic region for Honeywell Aerospace's three segments, Defense & Space, Commercial Aircraft and Business Jets. Do you have any plans to initiate new collaborations between the Turkish Defense and Aerospace Industry and end users as well as companies from the region, which you oversee (which covers the Czech Republic, Poland, Romania, Hungary, Serbia and Ukraine – as well as Turkey and the Turkic Republics)?**

**Serdar ÇETİNGÜL:** We are constantly working on services and solutions that provide the best in experience and safety for our customers, which often includes collaborating with trusted local companies. Honeywell Aerospace products and services are found on virtually every commercial, business and defense aircraft. We build aircraft engines, cockpit and cabin electronics, wireless connectivity systems, mechanical components and more for both commercial and defense customers.

Because our product portfolio is so broad, there are many opportunities for us to succeed in both Central and Eastern European countries and Turkey, where there are clear commitments from respective governments to evolve their organic aerospace industries through technological excellence. At Honeywell Aerospace we seek opportunities to partner with domestic companies in each of our markets to deliver advanced technologies for new and existing platforms, and to continue our tradition of transferring the skills and expertise to help them strengthen their own capabilities. Our Integrated Supply Chain team is very active in Turkey, looking for additional opportunities to leverage Turkish companies' excellent capabilities. I am very optimistic about finding opportunities that help both regions by enhancing regional capabilities.

**Defence Turkey: Can we please get an analysis of 2019 from Honeywell Aerospace's point of view and could you elaborate on your targets and expectations for 2020? Do you expect any negative impact stemming from the globally spreading novel type Coronavirus?**

**Serdar ÇETİNGÜL:** 2019 was very positive year, in terms of growth, for both our commercial and defense businesses within my region of responsibility. With constant improvements to safety, operational efficiency and maintenance capabilities, together with new product introductions and connected solutions, the future also looks positive.

*T625 GÖKBEY TLUH*

Honeywell continues to monitor the coronavirus situation and its impact globally. We are prioritizing the health and safety of our employees and are working with all our customers and suppliers to evaluate and minimize any potential disruptions.

**Defence Turkey: What could you tell us about the international presence of Honeywell Aerospace in the military rotary-wing sector, and the international programs that you have been involved in recently?**

**Serdar ÇETİNGÜL:** Honeywell has long been trusted and respected in the military rotary-wing sector. We have created a range of solutions, designed to enable and support mission-readiness for different missions such as VIP transport, firefighting, air ambulance, law enforcement, military, oil & gas and search and rescue. Apart from providing Retrofit, Modification and Upgrade (RMU) technologies for helicopters to improve safety, lower cost, reduce pilot workload and increase mission success, we are on-board major helicopter fleets such as the UH-1, UH-60, T70, ATAK, CH-47 and T625. Honeywell's key aim has been to enable the Connected Helicopter, much as it has enabled the Connected Aircraft. Our tried-and-tested technology solutions have been, and are being, adapted for rotorcraft, providing everything from in-flight connectivity to connected maintenance.

**Defence Turkey: What kind of new products do you see a demand for in the coming years? What types of new products and services can the industry expect to see from Honeywell Aerospace?**

**Serdar ÇETİNGÜL:** From a global perspective, last year we announced the launch of Honeywell Forge for Airlines and recently this year for Business & General Aviation, which continues to be a huge focus and has been a great success with our customers. Honeywell Forge is the most sophisticated analytics platform for airlines, which delivers efficiency solutions, drives higher profits and increases aircraft availability. We also made some significant strides in the Urban Air Mobility (on-demand and automated passenger or cargo-carrying air transportation services, typically flown without a pilot) space for avionics, navigation, flight controls and connectivity, working with some of the industry's most innovative companies. We are seeing connectivity play an increasing role across the industry, something that we know will continue throughout this year and far beyond.

**Defence Turkey: Can you elaborate on where Turkey falls in the strategies of Honeywell Aerospace, in out-sourcing and building up a global supplier network and how could Turkey improve its contribution?**

**Serdar ÇETİNGÜL:** We are constantly looking at our entire Honeywell portfolio, within commercial and defense products. If we see the opportunity to reduce cost or improve turnaround time or reliability by collaborating with the local industry, then we leverage existing capabilities and expertise, enabling companies to become part of our global supply chain. We have established very successful and strong relations with aerospace companies to date, which will continue in the future.

**Defence Turkey: Can you elaborate on the current status of collaboration between Turkish Defense and Aerospace Sector companies (such as Alp Aviation, Aselsan, TEI, TUSAS and Dormak) and Institutions (such as ASFAT) and Honeywell Aerospace? Do you have any near future plans to explore further opportunities to expand the extent of cooperation between Turkish companies and Honeywell and to sign further cooperation agreements with other Turkish companies?**

**Serdar ÇETİNGÜL:** Honeywell's long-standing technological heritage, combined with its understanding of business in Turkey, means it can bring advanced systems into the country that extend military capabilities and upgrade existing platforms and systems. This regional knowledge also allows Honeywell to align itself to the needs of Turkey's growing domestic defense companies. Working with previously mentioned organizations to bring new, advanced capabilities to Turkey's native defense industry makes for an exciting time building the future of the aerospace industry together.

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*T129 ATAK*

**Defence Turkey: You are providing CTS800-4AT turboshaft engines under the T625 GÖKBEY TLUH Development Program, of which the prototype stage is intended to be completed by the end of 2020. Can you elaborate on the current status of CTS800-4AT turboshaft engine deliveries to TUSAS- How many engines have been delivered so far?**

**Serdar ÇETİNGÜL:** Both T129 and T625 are strategically important programs for us from the engine perspective. Both platforms are essentially using the same engine. T129 ATAK is a very successful platform offering high performance and tremendous capabilities that deliver outstanding mission success. Our LHTEC CTS800 engines play an important role in this success. The next step will be the export of the T129 ATAK to other countries and we are actively supporting this initiative. In comparison to the T129 ATAK, the CTS800 provides superior performance, especially in high altitude and hot weather conditions, meaning the platform can deliver mission success in a wide variety of operating environments and therefore extending its attractiveness to a wider export market.

T625 GÖKBEY is the first native multi role helicopter development for Turkish Aerospace. The same LHTEC CTS800 engine has been selected as part of this important strategic national project. T625 made its maiden flight on 6th of September 2018 and will undoubtedly be another success story for Turkey. For the T625, we have delivered 10 engines within the development phase of the program.

**Defence Turkey: Can you elaborate on the current status of ongoing efforts for the establishment of CTS8004A Engine Depot Level Maintenance (DLM) capability in Turkey. The SSB has identified TEI for this duty. Has the CTS8004A DLM facility established within TEI become operational? Who will operate this depot, TEI or Honeywell?**

**Serdar ÇETİNGÜL:** This is another exciting program for us. With this project, we have an authorized channel in the region for the LHTEC engine, a 50-50 working relationship between Honeywell and Rolls-Royce. TEI will operate the depot and will be responsible for Depot Level Maintenance Capability for CTS800 engines. A depot stand-up phase program will be initiated in Q1 2020. LHTEC is working very closely with the TEI team to establish this maintenance, repair and overhaul capability alongside TEI.

**Defence Turkey: On October 14, 2019 Honeywell announced that they were finalizing a modernization solution developed for the T55 turboshaft engines, which are used aboard CH-47 Chinook helicopters. The latest version of the T55 makes numerous improvements to the previous engine including; over 20% more power at sea level, around 10% more power at high and hot altitudes and 9% less fuel consumption. According to the press bulletin the modernization solution will take the form of both a new engine and a more cost-effective kit to upgrade the existing engines to the latest version. The Turkish Land Forces currently operates T55-GA-714A turboshaft engines on its CH-47F Chinook Heavy Lift Helicopters. Do you have any plan to establish a DLM for this engine in Turkey and is there any interest from Turkish end users in your new T55 engine upgrade?**

**Serdar ÇETİNGÜL:** We are continuously at work to update and improve our engine systems, such as the T55, and this announcement was no exception. The modernization has seen

improvements in reliability and maintainability, as well as lower maintenance costs. We do currently have plans to establish a DLM for the T55 in Turkey. We have seen interest from Turkish end-users who would like to seek improved turnaround times, and better support to ensure fleet readiness levels and sovereign capability for depot maintenance and overhaul of the T55 engines.

**Defence Turkey: Honeywell has established a collaboration with Alp Aviation under the F-35 JSF Program to produce some complex mechanical parts of the aircraft's landing gears. However, Turkey was officially excluded from the F-35 Lightning II JSF Program on July 16, 2019 as a result of the S-400 crisis encountered with the US Government. The local Turkish companies presently conducting production and deliveries, according to their work shares as part of the program with the best value approach, were excluded from the program after March 2020 (has not officially declared, yet). How has Honeywell's existing cooperation with Turkish companies under the F-35 Lightning II JSF Program evolved or changed after Turkey's partnership to the JSF Program was suspended?**

**Serdar ÇETİNGÜL:** Honeywell consistently evaluates its portfolio, across commercial and defense products. When we see an opportunity to make a difference and improve efficiencies, or offer cost savings, we work closely with our customer and partners to leverage existing capabilities and expertise. This gives companies the chance to be part of our global supply chain and is why we do not align our collaboration with the Turkish industry to specific projects.

*The Turkish Land Forces currently operates T55-GA-714A turboshaft engines on its CH-47F Chinook Heavy Lift Helicopters*

**Defence Turkey: Can you elaborate on your short and long-term objectives, your vision for Turkey?**

**Serdar ÇETİNGÜL:** Turkey remains an important growth market for Honeywell Aerospace. We remain very active in developing and manufacturing products that are utilized in our country. For example-- the AB205, AH-1, UH-1, UH-60, T-70, ATAK, CH47 and T625 helicopters and CN-235, T-38, Hürkuş, F-16 and C-130 aircraft all contain Honeywell products. Turkey's government has made clear its objective of developing a truly indigenous, exportable defense industry. The benefits to the country are significant, enabling even more growth for Turkey's increasing number of successful and capable defense and aviation engineering corporations. Becoming a global player requires partnership success between Turkish engineering giants and the world's most successful, established and advanced technology manufacturers – companies like Honeywell.

With a long heritage in Turkey, Honeywell is partnering with key players like Turkish Airlines, Pegasus, Turkish Aerospace, Aselsan, ALP Aviation, TEI, Roketsan and MNG Jet to bring new, advanced capabilities to Turkey's indigenous defense industry in areas such as propulsion, power systems, navigation, guidance, air thermal systems, and retrofit modification & upgrades. Our goal is to be a trusted strategic partner that delivers added value every step of the way.

**Defence Turkey: Would you like to add any final comments or a message for our readers?**

**Serdar ÇETİNGÜL:** Turkey's position at the business crossroads of Western and Eastern Europe, the Middle East, and Africa makes it a strategically important market for Honeywell. We are engaging all key defense and commercial players, along with other operators across the country to show how our aerospace technologies can simultaneously lower costs, increase safety and mission success, and improve the passenger experience from check-in to baggage claim.

Honeywell is very proud of its legacy in Turkey. Since first establishing our presence in Istanbul in 1992, we have grown to employ around 300 employees in three cities across the country and Turkey's importance as a strategic region for our business continues to increase. Honeywell Turkey is committed to improving its customers' business performance through increasing safety, reliability and efficiency by delivering the best proven engineering solutions available ■

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# MELTEM-III Project & ATR-72/600 TMPA

by İbrahim SÜNNETÇİ

**Produced under the MELTEM-III Project, the first ATR-72/600 (tail number TCB 751) Turkish Maritime Patrol Aircraft (TMPA) was sent to Italy in 2016 for certification tests after its structural modifications were completed at TUSAŞ facilities, and arrived in early March 2019 to carry out the final tests before its delivery. The first ATR-72/600 TMPA successfully passed certification tests and landed at Turkish Aerospace's facilities in Kahramankazan, Ankara and will be delivered to the Naval Forces Command in the coming days after the final tests are completed.**

**In this article, we will first examine the MELTEM-III Project and then share information about the technical characteristics and capabilities of the ATR-72/600 Maritime Patrol Aircraft. In the last part of our article, we will briefly introduce the P-72A M/P Aircraft, which is also based on the ATR-72/600 platform and is still flown by the Italian Air Force.**

With the MELTEM-III Project, which is the last of the MELTEM Programs and valued at approximately US$218.7 Million [€180 Million, the cost of the AMASCOS-300 Mission System procured under the MELTEM-II Project is not included in this figure, merely the aircraft procurement, structural modification, test and certification costs are covered] two ATR-72/600 utility aircraft in TMUA (Turkish Maritime Utility Aircraft) configuration entered the inventory and were inducted into the service of the Turkish Navy in July and August 2013.

Within the scope of the project, a further six ATR-72/600 Maritime Patrol (M/P) Aircraft with Anti-Submarine Warfare (ASW) and Anti Surface Warfare (ASuW) capabilities will also be procured. According to the official website of the Turkish Naval Forces Command (TNFC), the delivery of six ATR-72/600 Turkish Maritime Patrol Aircraft (TMPA) will take place during 2019 – 2020. The structural modification activities on the ATR-72/600 Utility Aircraft with tail numbers TCB701 and TCB702 were performed by the Prime Contractor Alenia Aermacchi/Leonardo at Napoli-Capodichino and Torino-Caselle facilities. To this end, the aircraft were equipped with new radio sets and an IFF system.

The contract of the Meltem-III Project, covering the procurement of a total of 6 ATR-72/600 aircraft and their modification into ASW and ASuW configuration for the Turkish Navy, was signed between Alenia Aermacchi S.p.A and Turkish Aerospace (TUSAŞ) in July 2012. The agreement is an amendment to a previous deal signed on July 20, 2005 and became effective in April 2006 between Alenia and the Turkish Government for the delivery of 10 ATR-72/500 ASW aircraft to the Turkish Navy. Within the framework of the project, as the Main Sub-Contractor of Alenia/Leonardo, all related modification activities to convert the 'green' ATR-72/600 in ATR-72/600 TMPA will be carried out at Turkish Aerospace's facilities. Turkish Aerospace's work share includes Kit-A and tools manufacturing, procurement of material and support equipment, structural and electrical modification, assembly, test, Ground Flight Support, and Integrated Logistics Support (ILS) activities.

According to the original schedule, upon the completion of the certification and acceptance tests, the first of the six ATR-72/600 TMPAs was planned to be delivered to the Turkish Navy in February 2017. The remaining five TMPAs were intended to be delivered by the end of Q1 2018. However, the first ATR-72/600 green aircraft to receive Structural Modification could only arrive at Turkish Aerospace's facilities on April 19, 2013, and modification efforts were launched in the same year. Following the completion of the Structural Modification (covering the integration of Airborne Maritime Situation Control System-300 [AMASCOS-300] mission equipment and converting the green aircraft into an MPA with ASW capabilities) activities, the first aircraft accomplished its maiden

flight on July 14, 2016, and was sent to Torino/Italy for the execution of certification tests by the Italian Certification Authority (DAAA) and Finmeccanica, on the same day. The second aircraft was sent to Torino, Italy, in April 2017 upon the completion of the Structural Modification. The flight tests were executed at the Flight Test Center of the Alenia Aermacchi/Leonardo Company in Torino.

The delivery date of the first ATR-72/600 TMPA was later postponed to May 2017, but due to the difficulties arising during the certification tests, the delivery mentioned above could not be actualized. At a press meeting held on May 10, 2017, during IDEF '17 Fair in response to our question on whether the first ATR-72/600 Turkish Maritime Patrol Aircraft would be delivered to the Turkish Naval Forces in May, the Vice President of Leonardo in charge of Strategy, Markets, and Business Development Giovanni SOCCODATO stated that due to the delays which occurred in the certification process, the delivery would be accomplished in the second half of 2017.

Meanwhile, procured within the scope of the MELTEM-III Project, eight of the ten AMASCOS-300 Mission System sets to be utilized in the ATR-72/600 TMPA platforms powered with two PW127M turboprop engines produced by P&W Canada were received as of April 2014, and the remaining 2 AMASCOS-300 Mission System sets were delivered in September/October 2014. Six of the


*The First Turkish ATR-72 MPA is seen in course of modification efforts in 2014, Turkish Aerospace facilities*

aforementioned Mission Systems would be utilized in the 6 ATR-72/600 aircraft to be delivered in Turkish Maritime Patrol Aircraft (TMPA) configuration, while the remaining four would be stored to be used as backups for securing the lifetime maintenance and operation of the AMASCOS-300 Mission System deployed at both in the P-235 (CN235-100M) and ATR-72/600 TMPA Maritime Patrol Aircraft of the Turkish Navy.

While the P-235 MPAs, equipped with Link-11 Tactical Data Link System, can carry Mk46 Lightweight Torpedo and Depth Bombs at the external hardpoints/pylons under the wings, the ATR-72/600 ASW/ASuW aircraft can carry the weapon load on two pylons at the fuselage sides (they lack the underwing pylons for external payload due to their wing designs) will additionally feature the Link-16 Tactical Data Link and Mk54 Lightweight Torpedo capabilities. Via the Link-11 Tactical Data Link System operating at the HF band, data communication could be conducted up to the range of 200km+ at the Line of Sight (LoS). The engineering support required for the integration of the Mk46 Mod 5 and Mk54 Lightweight Torpedoes to ATR-72/600 TMPAs is provided by the company Raytheon. To this end, a contract worth US$5.7 Million was signed between the Main Contractor Alenia Aermacchi and Raytheon in July 2014.

The ATR-72/600 does not have an internal weapons bay; instead, it carries its weapon load on two external pylons on the fuselage sides. Although installing the pylons on sides of the fuselage prevents the wings, the most fragile elements of the aircraft, from being affected by excessive loads, the external weapon load considerably reduces the aerodynamic performance of the plane, thereby leading to increased fuel consumption and reduced mission performance. Moreover, the very slow-cruising and patrol speeds (patrol speed of ATR-72/600 is 130 knots-240km/h) create additional drag (air resistance), which further affects the aircraft's performance to a certain point. Thus, the pylons are installed tangentially on the lower edges of the fuselage.

Technically the ATR-72/600 MPA platforms can be equipped with four pylons in total, two in front of the landing gear bays, and two at the rear of the aircraft (I have not seen any pictures of ATR-72 aircraft equipped with these pylons). Two additional pylons can also be installed on the plane just behind the front landing gear. The pylon on the starboard side (right) of the fuselage can carry up to 200kg and generally carries the Spectrolab SX16E searchlight and Thiokol LUU-2B/B flare launcher. Spectrolab SX16E searchlight, which can work in both visible and infrared lighting spectrums, has a power of 100 million candles and can be slaved to the movements of the 'spherical' optronic turret. Thiokol LUU-2B/B launcher has a capacity of 6 illumination flares. The pylon on the port side (left) of the fuselage, on the other hand, can carry a pod-mounted 12.7mm FN M3P machine gun.

Each pylon weighs around 40kg and has a maximum capacity of 1,000lb (454kg). The ATR-72/600 can carry

two 324mm lightweight torpedoes (about 250kg), depth charges (around 160kg), Penguin Mk2 Mod 7, NSM, SOM-J (all around 400kg), or the lighter Marte Mk2/S and its new version Marte ER Anti-Ship Guided Missiles with two pylons on either side of the fuselage. In the standard configuration, two light torpedoes can be mounted on the front pylons and two depth charges on the rear pylons. As an alternative to bombs, two Penguin (AGM-119B) Mk2 Mod7 type Anti-Ship Guided Missiles can also be mounted on the pylons. The pylons need to be modified to use other types of missiles. However, neither the Turkish Maritime Patrol Aircraft platforms to be delivered to the Turkish Navy nor the four P-72A aircraft operated by the Italian Air Force can launch Anti-Ship Guided Missiles.

The Airbus Defence & Space (ADS competed in the MELTEM-III tender with the ATR-72) product C295 Maritime Patrol Aircraft (MPA) can technically be installed with three separate underwing hardpoints/pylons with a capacity of 800kg, 500kg, and 300kg respectively. Having certified the Mk46 Light Torpedo for the C295 aircraft of the Chilean Navy, ADS Military Aircraft also integrated the MBDA product Marte Mk2/S Anti-Ship Guided Missiles in 2012 to improve the aircraft's air-to-surface performance. In this context, the Marte Missile was integrated into the same external pylon carrying the Mk46 torpedo with a small modification to the ejector, and its certification was completed after the firing tests which

*AMASCOS -300 Mission Systems Consoles of CN-235 TMPA*

were carried out in 2013. Weighing 310kg, the Marte Mk2/S Anti-Ship Guided Missile is 3.85m in length, 316mm in diameter, and has a range of over 30km. Upgraded with a Turbojet engine, the third generation Marte ER Anti-Ship Guided Missile is 3.60m in length, 316mm in diameter, and weighs around 315kg. The Marte ER can reach a range of over 100 km.

The AMASCOS-300 Airborne Maritime Situation Control System deployed both in the CN235-100M (P-235) and ATR-72/600 ASW/ASuW aircraft, features a total of four operator consoles (Radar Operator, Tactical Coordination Officer [TacCo], Acoustics Operator and Electronic Warfare (EW) and Communication Operator) and includes: the Ocean Master 400 Search Radar with a range of 190nm, in 400W power and with SAR/ISAR/SPOT-SAR/STRIP-SAR/MMTI capabilities, the AselFLIR 200T FLIR System enabling the identification of surface contacts up to a 35nm range, Sonobuoy Launcher, TMS-200 Active/Passive Sonobuoy Processing System (for the sonobuoys, capable of listening to 16 sonobuoys simultaneously), TCAS II Air Traffic Collision Avoidance System, DR-3000 Electronic Support Measures (ESM) [functions also as an RWR), AN/ASQ-508(V) Magnetic Anomaly Detector (MAD) with an antenna length of 4.5m and an antenna weighing nearly 50kg, Link-11/Link-16 Tactical Data Link Systems, LN-100G INS/GPS, ARS-700 Airborne Rescue System, APX-113 IFF System and Aselsan's ASES-235 EW Integrated Self-Protection System containing the AN/AAR-60 MILDS MWS and four AN/ALE-47 CMDS Launchers. Three million lines software was developed for the real-time AMASCOS-300 Mission System within the scope of the Program. The Ocean Master 400 Radar with a mechanically rotated antenna array is capable of detecting a submarine periscope from a 30nm range at an altitude of 1,000ft under favorable weather conditions, and a patrol boat from a 90nm range at an altitude of 6,000ft within an area of 100 square meters.

With the AMASCOS-300 Mission System, the data from dozens of sensors on the aircraft are processed quickly, and a complete picture of the operation area (including surface, air, and underwater) is provided with proper symbology on Multipurpose Operator Console (MOC) screens. This capability, which is a must for creating a complete picture of the operation area, played a significant role in the project's delay. Thales has faced significant technical problems in developing/integrating a computer that can process data from so many sensors in a very short time and the software to run on it and has suffered more than €50 million in losses. Thales Alenia Space (TAS) wrote 3 million lines of code for the real-time AMASCOS-3000 Mission System solely to solve this problem.

To give an idea about the mission duration of an ATR-72/600 MPA platform in the ASW role, let's suppose that a Maritime Patrol Aircraft detected a periscope, identified the target and launched two torpedoes at the hostile submarine while performing a submarine warfare mission at a distance of 200 nautical miles from its base at an optimum cruising altitude and speed (5,000ft surveillance altitude and 130 knots patrol speed). In this mission profile, the aircraft can stay in the air for 6.5 hours. According to open sources, the MPA can operate for approximately 8.5 hours, considering the approximately 1,000-nautical mile distance and the 6-hour patrol time, including the 30-minute attack time. In this case, the maximum flight time of the aircraft (10 hours in Search and Rescue mission, more than 8 hours of this is reserved for surveillance mission) will be just over 2 hours in an operational area 600 nautical miles from the base, and 3.3 hours in an operational area 400 nautical miles away.


## P-72A/ATR 72 Maritime Patrol Aircraft

A €260 million contract was signed in December 2008 between the Ministry of Defense of Italy and Alenia Aermacchi/ Leonardo to supply four P-72A Maritime Patrol Aircraft for the Italian Air Force. Under the contract, the first plane would be delivered in 2012, while the other three would be delivered in 2013. However, as in the MELTEM-III Project, there was a significant delay in the project and the first two P-72A Planes, which will replace the veteran Breguet Atlantic 2 Planes in service, were delivered to the Italian Air Force in December 2016. The Italian Air Force also signed a US$137.4 Million (€100 Million) contract with Leonardo in November 2011 to receive five years of technical and logistical support for four aircraft. Leonardo Aircraft also sold a total of four P-72B (ATR72/600) Maritime Patrol Aircraft (one plane under the contract signed in July 2018 and three aircraft under the contract signed in October 2019 at over €150 million) and necessary logistics support services to Guardia di Finanza (GdF - an Italian law enforcement agency under the authority of the Minister of Economy and Finance). The first aircraft was delivered in November 2019, and the other three planes are expected to be delivered by 2022.

A new mission system was preferred for Italian ATR-72/600 Maritime Patrol Aircraft known as P-72A. Developed by Selex Galileo and known as Airborne Tactical Observation and Surveillance-Enhanced (ATOS-E), this system forms the heart of an almost entirely domestic production mission hardware. The system developed by Selex Galileo belongs to the generation following AMASCOS and is a higher performance and flexible solution depending on the sensors used. The open and modular architecture of ATOS can integrate and support various sensors and functions. The only significant feature of the ATOS Mission System that is missing compared to AMASCOS is the complete data fusion, which is used to detect/classify targets. The four Multi-Purpose Operator Consoles (MOC) widely incorporate commercially available COTS (Commercial Off-The-Shelf) components to reduce costs and simplify configuration.

*The Cockpit of Italian ATR-72/600 dubbed as P-72A MPA*

Compared to the MELTEM-III Project, the Italian P-72A Planes have more modern equipment in terms of Mission System Sensors. Because while the MELTEM-III Agreement was signed in 2005, the AMASCOS-3000 Mission System order was placed under the MELTEM-II agreement signed in 2002. Therefore, there is a difference of about ten years in terms of sensor technology. The most noticeable differences in the hardware (Mission System hardware) between the ATR-72/600 TMPA and the P-72A are the Selex Galileo/ Leonardo SeaSpray 7300E X-Band AESA (Active Electronically Scanned Array) Radar, FLIR Star SAFIRE 380-HD EO/IR Imaging System, integrated broadband SatCom System and AN/ ASQ-508(V) Magnetic Anomaly Detection (MAD) system.

Although a capable system, it is impossible to compare Ocean Master with the SeaSpray 7300E Radar. Selex's AESA radar has superior performance in every respect. Especially the

detection distances are superior to a mechanically scanned radar in terms of multimode flexibility and reliability (2,000 hours mean time between failures). The SeaSpray 7300E has SAR/ISAR (Synthetic Aperture Radar/Inverse Synthetic Aperture Radar) modes, sub-meter resolution, and excellent MTI/GMTI modes. Moreover, the FLIR Star SAFIRE 380-HD EO/IR System is a more superior product compared to the AselFLIR-200. Consisting of a 6-axis gyro-stabilized round turret, the system includes a 3-5 µm Mid-Wave Infrared (MWIR) camera with native 1280 x 720 resolution and 120x-magnification, a long-range HD Color CCD camera, a Color NIR (Near-infrared) low-light CCD camera and multiple laser payload options (eye-safe rangefinder, illuminator or pointer). This system's performance is excellent in terms of sensors, as well as targeting accuracy and stability (less than 0.5 rad).

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*Pakistan Navy ATR 72/500 MPA was displayed at PAS'19*

## Pakistan Navy and ATR 72/500 Maritime Patrol Aircraft

As of April 2020, the Pakistan Navy has two ATR 72/500 (ATR-72-212A) Maritime Patrol Aircraft with tail numbers 78 and 79, respectively. The planes, known as the 'RAS 72 Sea Eagle', had previously been in service with the PN as utility/transport aircraft. These two planes were converted into Maritime Patrol Aircraft (MPA) with ASW capabilities under an agreement signed in early 2015 with the Rheinland Air Service (RAS), Maintenance, Repair, and Overhaul (MRO) company located in Mönchengladbach, Germany. The first plane (tail number 79) was delivered in June 2018, while the second plane (tail number 78) was transferred to the Pakistan Navy in June 2019. Following the completion of the acceptance tests conducted after their transfer by RAS, the first (tail number 79) and the second (tail number 78) RAS 72 Sea Eagle MPAs re-entered service with the PN with official ceremonies held at Naval Air Station PNS Mehran in Karachi on December 12, 2018, and on January 4, 2020, respectively. At the ceremony held on January 4, 2020, another ATR-72 Aircraft (tail number 76) in the transport/airdrop configuration entered the Pakistan Navy service. While the structural modification activities carried out for the conversion of the first aircraft into the Maritime Patrol Aircraft took 15 months, the work on the second aircraft was completed in 12 months.

Rheinland Air Service (RAS) introduced Pakistan Navy (PN)'s second ATR-72/500 (tail number 78) Multirole Maritime Patrol Aircraft (MPA) with ASW capabilities to the public at the 2019 Paris Air Show. The first ATR-72/500 Aircraft (tail number 79) was exhibited with another ATR-72 aircraft (tail number 77) in utility configuration during the ceremony, held on the last day of the AMAN-19 Multinational Maritime Exercise held in Karachi on February 8-12, 2019.

According to an RAS official, whom we had the opportunity to meet with during the 2019 Paris Air Show held June 17-23, the Pakistan Naval Air Arm performed over 300 missions that accumulated 500+ flight hours with the first aircraft. He also pointed out that the Pakistan Navy has the intention to convert three more ATR-72s into MPA configuration, but it depends on budget allocations. At the Pakistan Navy's request, the P127F engines of the PN RAS 72 Sea Eagle MPAs, which features a semi glass cockpit, were upgraded to the P127M engines (2.750shp) used in ATR-72/600 Aircraft. The MPAs are fitted with the Aerodata AG Company product AeroMission Mission Management Systems (MMS). The system has four Operator Consoles placed side by side in tandem configuration inside the cabin. Thanks to its sensor fusion algorithms, the AeroMission MMS can process the data from the aircraft's sensors during the flight and transfer it to the relevant Ground Control Station (GCS) in real-time through modern communication systems on the plane. According to an RAS official, the operator consoles onboard the RAS 72 Sea Egle MPA can be pulled out from the cabin within 2 hours thanks to their modular concept.

*A244/S Mod 3 lightweight ASW torpedoes*

The RAS 72 Sea Eagle Multirole MPAs are equipped with the Leonardo Seaspray 7300E Active Electronically-Scanned Array (AESA) radar, Elettronica ESM/ELINT suite, FLIR Systems Star SAFIRE III high definition electro-optical and infrared (EO/IR) turret, an Acoustic Processing System, Sonobuoy Launching System, Chaff and Flare Dispensing System, Ku-Bant satellite communications (SatCom) system, AIS transponder, Direction Finder, IFF, and PN specific indigenous data-link system (Link Green). The planes are not equipped with a Magnetic Anomaly Detection (MAD) system, and they can fly for more than 9 hours at maximum fuel capacity. The platform also features two weapon pylons for Italian A244/S Mod 3 lightweight ASW torpedoes (around 265kg), enabling anti-submarine warfare (ASW) and maritime patrol capabilities. According to customer request, a total of four external pylons, (two in the front and two in the back) can be installed on the aircraft. In addition to light torpedoes (Such as Mk46 or A244/S), the front pylons can carry air-launched Anti-Ship Guided Missiles, which ignites their engines in mid-air after they are released from the pylon (such as the Penguin Mk2).


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# Masttech's New Generation Mast Systems and Carrier Platforms Expanding into New Markets

**President of Masttech, Koray GÖKALP shared details about Masttech, their organizational structure, new and unique products, and the partnership agreement with US-Based Will-Burt company in 2019 that positioned the company in the overseas market.**

**Defence Turkey: Could you please provide some background on Masttech and its establishment at the Sincan Organized Industrial Zone in Ankara, and the current organizational structure of the Company?**

**Koray GÖKALP:** Our journey, which we started with the delivery of defense industry engineering services in 1988, has been continuing with the most advanced engineering activities in the sector, such as design and system development since 2007. At the beginning of 2019, after we believed that we had reached maturity in terms of our skills, experience and financial power to take part in the international defense industry, we were in search of a new vision. We carefully analyzed our strengths and weaknesses to determine the areas in which we could compete, and which areas would be more difficult. Our engineering and manufacturing expertise was also quite competitive in the international defense industry market. Since marketing in the global defense market requires a relatively long time and involves great effort, a powerful brand, political power, and strategic requirements, we started to look for a partner with which we could combine our strengths and to eventually become a useful model. Upon this search, Masttech was formed following our agreement with the U.S. Company Will-Burt, which has been the world leader in its own product group for more than 100 years and has also incorporated the German company Geroh which has an important share in the global market with the same product group as well. Thus, Masttech found its place in the sector as the latest Turkish company established with a Turkish-American partnership in the defense industry.

**Defence Turkey: How did you achieve this during the difficult period in the Turkish-American relationship in 2019?**

**Koray GÖKALP:** Even though certain interests confronted both countries from time to time, Turkey and the United States are two allied countries. These two countries have the largest armies in NATO. Our mutual interests are much more than those we oppose. Thus, we have proven this with our partnership.

**Defence Turkey: Is the Turkish market your first priority?**

**Koray GÖKALP:** Of course, Masttech will give priority to the needs of the Turkish market, but we were already in the Turkish market, Molekulas established this partnership to become a global company.

With this structure, Masttech is a first in our country's defense industry and more than 90% of our current sales portfolio is composed of exports. Offering very significant technological and cost advantages to its customers is one of the key features of Masttech. For this reason, we plan our investments by projecting that our domestic and international market share will increase substantially over time.

**Defence Turkey: Could you specify your vision briefly? How will Masttech and Will-Burt position themselves in the global market?**

**Koray GÖKALP:** Masttech is now entering the market with new product lines, not previously manufactured by Will-Burt and Geroh. Thus, the entire Will-Burt sales team will market our products as well. These new generation mast systems and carrier platforms allow us expanding into new markets. Thus, we headed out with a vision based entirely on the union of forces, not competition. In addition, we will be able to produce other mast systems of the Group under the conditions which we deem logistically


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advantageous, and we will be able to make the necessary engineering changes in Masttech accordingly. In the meantime, Masttech has assumed the maintenance, repair and logistics activities of thousands of systems belonging to the Group and previously produced by our partners and used in our country and in the region. This made former Will-Burt and Geroh customers quite satisfied. Activities related to integrated logistics have generated more export revenue than we anticipated. We can now offer more rapid and cost-effective solutions. We are very pleased that we have formed a cooperation based entirely on our mutual interests, not based upon any offset obligation. I am proud of the level that our country has reached in the defense industry.

**Defence Turkey: Will the sales of Will-Burt and Geroh products in our country be conducted by your Company?**

**Koray GÖKALP:** Yes, this is entirely a collaboration. We see the whole Group as a single Company. Domestic sales of all products and spare parts of the Group as well as the maintenance services will be conducted by Masttech.

**Defence Turkey: Could you please inform us on the competitive capacity of Masttech in the domestic and foreign markets?**

**Koray GÖKALP:** As partners, we use all the technological superiorities and strategic strengths that our countries have. We attend more than 100 international fairs and events every year. This year, the COVID-19 pandemic has adversely affected our marketing activities but being number one in the world market places us among the least affected.

Defence Turkey: Turkey today makes direct procurements not to be dependent upon foreign manufacturers and supports the use of domestic-indigenous products. As Masttech, will you be able to align yourself with this?

**Koray GÖKALP: Yes, certainly. Masttech is a company based on 100% Turkish-capital. Our customers will be able to purchase Masttech products as domestic goods without any restrictions whatsoever. Only the products of our partners will be imported, as previously done. Here, I would like to especially mention that in our field, there is no product that our country needs, but we cannot produce, as a Turkish product. We develop the equivalents of many of our partners' products, and they are entirely owned by Masttech.**

**Defence Turkey: You have built a very modern and impressive factory at the Ankara Organized Industrial Zone. Has production started? Could you inform us about the local content rate?**

**Koray GÖKALP:** We start production in August this year. We are still making pilot productions for prototypes and mass production. 95% of the products will be produced by Masttech and local SMEs.

**Defence Turkey: Thank you for this interview**

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# The Key Role of Field Hospitals in the Fight Against COVID-19

by İbrahim SÜNNETÇİ

The Novel Type Coronavirus Outbreak (COVID-19), that first broke out in Wuhan/China in the last quarter of 2019, leading to 4,525,497 confirmed cases/patients and 307,395 deaths as of May 17, 2020 in 179 countries, spreading outside of China in a very short period of time, has deeply influenced social life and caused a series of changes in every field both in the world and in our country from production to consumption, from international relations to education, from transportation to entertainment, from worshipping to sports activities.

The fight against COVID-19 has forced us into an unprecedented predicament of mandatory social isolation, and we now frequently hear about Field Hospitals. A Field Hospital is a small mobile medical unit or mini hospital that temporarily takes care of patients and people affected by calamity or natural disasters on-site before they are transferred safely to permanent healthcare facilities. Large areas outside residential areas are generally preferred locations for Field Hospitals, which are established in the aftermath of disasters to provide safe and quick healthcare services to disaster victims.

As the number of patients increased, hospitals and health facilities started to become insufficient, and as a result, Field Hospitals started to be established by the Ministries of Health and military units in many cities of the world. Field Hospitals also started to be built by the Ministry of Health in Turkey and they were first established at border gates to prevent the virus from entering and spreading in Turkey. Within this scope, Field Hospitals were established by the Ministry of Health National Medical Rescue Team (UMKE) at the border gates with Syria, Iran, Iraq and Georgia in February and March as per the COVID-19 measures. Turkish citizens crossing border gates were subjected to medical observation in the Field Hospitals, which are typically built 200m away from the border gates. For example, 4 separate 100-bed Field Hospitals were established at the Sarp Border Gate, Çıldır-Aktaş Customs Gate and the Posof/Türkgözü Border Gate with Georgia within the scope of COVID-19 measures. Similar applications were also realized at the border crossings between Turkey and Syria-Iran. With the decision of the Ministry of Health, 6 Field Hospitals were established on the border line from Gaziantep-Karkamış to Mardin-Nusaybin on the Syrian border, and at the customs area at the Gürbulak Border Gate and the Kapıköy Customs Gate on the Iranian border by the National Medical Rescue Team (UMKE) consisting of the Ministry of Health professionals and volunteer healthcare providers. Citizens crossing border gates were admitted to our country after their medical checks and a 14-day isolation period in the Field Hospitals. Such Field Hospitals, where first line medical attention including minor medical operations can be performed, have played a significant role in the battle against the COVID-19 pandemic.


*1,000-bed Field Hospitals at Yeşilköy Atatürk Airport*

Then, it was announced on April 6, 2020 that 2 Field Hospitals would-be built-in Istanbul on the Anatolian and European Side as part of the fight against the COVID-19 outbreak. Following the announcement, the construction/installation work of two separate 1,000-bed Field Hospitals at Yeşilköy Atatürk Airport (as the Field Hospital is located right in the middle of the 17/35 right and left runways, the general aviation and cargo operations are carried out on the 05/23 runway, and both runways were torn down and made permanently unusable) and in Sancaktepe (former military land) were initiated in April in order to provide administrative, operational and humanitarian aid. As of May 20th, 2020, the construction/installation work of the Field Hospitals were being carried out uninterruptedly with 8,000 workers. The 1,000-bed Sancaktepe Field Hospital, which was announced to be built in a short period of 45 days, is planned to serve in an indoor area of 70,000m$^2$ and Atatürk Airport Field Hospital in an indoor area of 52,000m$^2$.

The official opening ceremony of these hospitals were held on May 29 and 31, 2020 respectively with the participation of President Recep Tayyip ERDOĞAN.

Additionally, an announcement was made that, in Kocaeli, which is one of the most affected cities by the outbreak, a Field Hospital would be established next to the Kocaeli Derince Training and Research Hospital, in the area where the former military hospital is located. But in April, only the preliminary work was performed in the area where Kocaeli Field Hospital would be built. According to the local newspapers, the rough construction work has not yet been started as of May 17th, even 1 month has passed since the beginning of the work. In the single-story 250-bed Kocaeli Field Hospital, which was announced to serve under the Derince Training and Research Hospital, all beds would have the features to be converted into intensive care beds. It was expected that 50 doctors, 100 nurses and 150 medical personnel would be assigned at the hospital, which is planned to be built on an area of around 15,000m$^2$.

*3rd Corps (NRDC-T) Deployable Rapid Assembly Shelters (DRASH)*

## Field Hospitals and the Turkish Armed Forces (TAF)

In some countries that are struggling with the COVID-19 outbreak, military health personnel have also stepped in and worked at the core of the struggle, and military Field Hospitals with their doctors, nurses and medical workers, have become the greatest support of the Health Ministries.

One of the users of the Field Hospitals in Turkey, except for the Ministry of Health and Disaster and Emergency Management Presidency, was the Turkish Armed Forces (TAF). For example, the 30-Bed Mobile Surgical Hospital and Mobile First Aid Station supplied by GAMA Holding under the 30-Bed Mobile Surgical Hospital Project conducted by the Presidency of Defense Industries (SSB) was delivered to the TAF with a ceremony held at the 4th Corps in Ankara on October 4, 2010. On the other hand, for the 3rd Corps (NRDC-T) stationed in Sarıyer/Istanbul, one of the 7 High Readiness Forces (HRF), which is the most concrete indicator of NATO's deterrence and solidarity, two Deployable Rapid Assembly Shelters (DRASH) were supplied to be used as a Mobile Surgical Hospital and Mobile Headquarter in 2007.

As in many armies in the world, there were military hospitals also in the TAF. The aim of Military Medicine is to train medical personnel, who are familiar with the military environment, know the psychology and have the knowledge of intervention methods to the injuries that will occur, for the health of personnel working in the troops and institutions of the TAF. Military Medical is carried on as a separate branch of science in the world.

Military Field Hospitals are demanding settings that require distinctive knowhow and experience. These are the systems that need to be established, operated and kept ready for military expeditions. Military Field Hospitals, which are accepted as a separate expertise, are operated by military doctors and personnel, with many examples found throughout the world.

However, in the aftermath of the July 15th Coup Attempt, all military hospitals, Gülhane Military Medical Academy (GATA) first and foremost, were attached to the Ministry of Health and the University of Health Sciences as per the Decree Law No. 669, which was published in the Official Gazette in August 2016, in other words they were closed. Operations Peace Spring, Euphrates Shield, Olive Branch and Spring Shield that had been conducted recently in Syria, as well as the recent earthquakes and the current COVID-19 outbreak have once again revealed the necessity of reestablishing the military health system.

## 30-Bed Mobile Surgical Hospital and Mobile First Aid Station

In the Mobile Surgical Hospital Project, which had been tendered several times since 2002 and canceled each time, the last tender was made in 2006 and 12 companies out of those 18 who obtained the RFP submitted their proposals. With the decision of the Defense Industry Executive Committee (SSIK) dated December 5, 2007, GAMA Holding was selected as the main contractor and a contract worth nearly EUR 17 million excluding taxes was signed with GAMA on September 28, 2008. According to the contract, the Mobile Surgical Hospital was planned to be delivered with all the components in May 2010, but the delivery was made on October 4, 2010. In the Mobile Surgical Hospital Project, which is a highly complex integration project that requires over 370 subsystems and equipment in different disciplines to be fully compatible, the design activities lasted approximately 14 months, and the testing and acceptance processes took more than 5 months. In this project, GAMA worked with Uniteam International located in Norway, as the subcontractor, which has experience in similar projects.

The 30-Bed Mobile Surgical Hospital and Mobile First Aid Station, which were supplied to provide rapid and effective healthcare services in both homeland security operations and natural disasters and outbreaks, were serving under the Medical Regiment of the TAF Health Command. Both Hospitals consisted of total 38 containers and 42 shelter tents. The emergency unit of the Mobile Surgical Hospital could become ready to serve within 2 hours, with all units in 3 hours, and the emergency unit of the Mobile First Aid Station within 1 hour and 15 minutes, with all units in 2 hours. In case of a military expedition, a total of 223 personnel, 31 of whom were medical doctors, 39 officers, 49 noncommissioned officers, 24 civil servants and 111 rank and file were rendering services in both hospitals. The hospital was able to serve in conditions between -32°C and + 49°C.

*The mobile first aid station of GAMA Holding's Mobile Surgical Hospital*

The structure of the Mobile Surgical Hospital and Mobile First Aid Station consisted of aluminum and steel containers and inflatable tents. All components that form the system could be transported to the duty station by tactical wheeled vehicles. The system was designed to be self-sufficient and ready to serve at any time with its generator, oxygen generator, fuel and water tankers, water treatment and wastewater unit, kitchen and laundry facilities in field conditions.

The Mobile Surgical Hospital had the capacity to provide healthcare support to a Corps. In the main treatment section, which consisted of 10 containers and 10 shelter tents, 4 major surgeries could be performed simultaneously, and 6 intensive care patients connected to the ventilator could be monitored. Although it had a capacity of 30 beds, the Mobile Surgical Hospital could reach a capacity of 60 beds when needed, and 206 beds in case of disasters such as earthquakes. The Mobile Surgical Hospital had a dental unit, decontamination, medical device maintenance, and morgue units, in addition to all units available in the Mobile First Aid Station. For the installation of the Mobile Surgical Hospital with all its units and equipment, an area of 7,000m$^2$ was required.

The Mobile First Aid Unit, which was designed as a Combat Support Hospital to provide healthcare support to a Brigade size military unit under combat conditions, consisted of containers and shelter tents that could be transported via tactical vehicles. Thanks to its modular structure, the Mobile First Aid Unit could reach a capacity of 18 to 30 beds, and 60 beds in cases of earthquake and disaster. A 3,500m$^2$-area was required for the installation of the Mobile First Aid Unit with all units and shelter tents, where 2 surgeries could be performed simultaneously, and 6 intensive care patients connected to the ventilator could be monitored.

*Mobile Surgical Hospital*

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## 3rd Corps Mobile Surgical Hospital

The Mobile Surgical Hospital (consisting of Role-1 First Responder Station and Role-2 limited hospitalization capability) supplied in 2007 for the 3rd Corps (NRDC-T) included 25 DRASH shelters and spread over an area of 2,038m².

Consisting of two 10-bed patient wards, 1 three-bed intensive care unit, 2 fully equipped operating rooms suitable for primary surgery, 1 fully equipped dental unit, digital x-ray device and ultrasound device, a pharmacy that can respond to treatment in field conditions, fully equipped biochemistry laboratory, food and hygiene laboratory, an outpatient unit and guidance counseling center, the Mobile Surgical Hospital was capable of meeting the medical aid needs of any operational environment. The Role-1 Unit of the Mobile Surgical Hospital, where only immediate treatment can be performed to patients and injured people, consisted of an observation room, examination room, psychological counseling unit, x-ray unit, pharmacy and a patient waiting room.

## CBRN Teams and Mobile Field Laboratory

Chemical, Biological, Radiological and Nuclear (CBRN) Teams are one of the military capabilities utilized worldwide in the fight against the COVID-19 outbreak.


*Military CBRN Teams*

Military CBRN Teams also served in Turkey; for example in early February, the decontamination/ disinfection activities were carried out by CBRN Teams of the Air Force Command at Etimesgut Military Airport after the 32-hour evacuation operation of the A400M Military Transport Aircraft, which brought Turkish citizens and citizens of friendly and allied countries from Wuhan city to Ankara in early February. The TAF CBRN Teams have also been assigned to disinfect the military vehicles coming from other operations upon their return to the country from such as Peace Spring, Euphrates Shield, Olive Branch and Spring Shield. In this context, the health status of TAF personnel coming from the operation fields are checked individually and the vehicles are disinfected by CBRN Teams at the border.

The Turkish Armed Forces (TAF) CBRN Academy and Training Center Command was established in 1930 and currently serves in Konya. The CBRN Defense Battalion Command,


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*Armored CBRN Mobile Field Laboratory*

which is the core element of the TAF CBRN Academy and Training Center Command, is also the only unit that supports the Land Forces Command in terms of CBRN defense and constitutes the backbone of the TAF for CBRN defense.

A CBRN Mobile Field Laboratory was supplied through joint production to be used in the detection, analysis and identification of Chemical, Biological, Radiological and Nuclear (CBRN) Warfare Agents and Toxic Industrial Chemicals for the further development of the existing CBRN capabilities of the Land Forces Command. Within the scope of the Armored CBRN Mobile Field Laboratory Project carried out by the Presidency of Defense Industries (SSB), a contract was signed between Spanish Indra Sistemas Company and the SSB on March 10, 2010, and an Armored CBRN Mobile Field Laboratory was designed and produced in collaboration with Indra Sistemas and Nurol Makina in 2013 and entered the Land Forces Command inventory.

Within the scope of the contract worth US$ 3.925 million, the Main Contractor Indra Sistemas collaborated with domestic companies such as the Main Subcontractor Nurol Makina (ISO 20" armored shelter, support for integration and technical issues) Aselsan (communication system), Oytek (software) and BMC (10-ton 6x6 tactical wheeled vehicle). In the Project, the system delivery of which was planned to be made in the 18th month following the start of the implementation schedule ($T_0$), the final acceptance activities were completed on March 21, 2013. The CBRN Mobile Field Laboratory System consists of a 6x6 Tactical Wheeled Vehicle, Armored Shelter, Shelter Lowering/Lifting Mechanism, and CBRN Laboratory Computerized Equipment and Support Systems. A 2.5m x 6m armored shelter was placed on BMC's 10-ton 6x6 tactical wheeled vehicle. The module (armored shelter), provides a clean and safe environment for the crew of three to perform chemical, biological, radiological and nuclear analysis on samples. It can be transported to the operation field by helicopter, cargo plane or ship when necessary. The system also includes a decontamination shower, which prevents possible contaminants from being transferred externally and internally.

The Qualification Tests of the CBRN Mobile Field Laboratory, which serves under the CBRN Defense Special Intervention Unit established within the TAF CBRN Academy and Training Center Command, were successfully finalized at an internationally accredited test center and the laboratory was certified in accordance with NATO standards. The Armored CBRN Mobile Field Laboratory System, under all weather and terrain conditions, provides exceptional ergonomics and uses algorithms that can support Detection, Identification, Monitoring, Analysis, Sampling, Decontamination, Protection and Command Control dynamics for CBRN threats. The self-powered system is able to continue its activities even in contaminated areas. The number of CBRN Mobile Field Laboratories within TAF, with the purchases to be made in lots, was expected to reach a total of 40, but no additional purchases have been made afterwards.

Within the scope of the Special Purpose Tactical Wheeled Armored Vehicle (ÖMTTZA) Project, the contract of which was signed between the SSB and FNSS on December 25, 2019, FNSS will deliver 5 PARS 8x8 CBRN Vehicles to the Land Forces Command ■


# New Priorities Shape the Defense Industry

*by Cem Akalın*

The Defense and Aviation Industry Performance Report prepared by the Defense and Aerospace Industry Manufacturers Association (SaSaD) was published on April 26 on SaSaD's website. According to the data, which is collected from sector players every year in April – May, foreign defense industry sales revenue in 2019 amounted to US$ 3.068 billion, while total domestic and foreign sales reached US$ 10.884 billion. According to the data, imports amounted to US$ 3.088 and the R&D expenses realized reached US$ 1.672 billion. Total employment increased to 73.771.

The Defense Industry's foreign sales revenue was announced as US$ 2 billion 740 million 988 thousand by the Turkish Exporters Assembly (TIM) in the last days of December 2019. When the latest up-to-date data is included from the members of SaSaD and also the data from foreign exchange generating services related to Defense and Aerospace (SSI) full year 2019, the foreign sales revenue of 2019 reached US$ 3.068 billion. In 2018, the foreign sales revenue was recorded as US$2.188 billion.

According to data the provided by SaSaD, the turnover per capita in 2019 increased to US$ 147.539 with an increase by 13% compared to the previous year while the total number of orders received fell by 12.56%. The total received orders in 2018 amounted to US$ 12.204 billion, and this figure dropped to US$ 10.671 billion in 2019.

After this substantial decrease in 2019, defense industry exports increased by 5% in the first two months of 2020. However, just like all sectors, the defense industry's export figures experienced a sharp decline with the coronavirus pandemic in March and figures decreased by 49.5% compared to the same month of the previous year.

SaSaD Secretary General Hüseyin BAYSAK evaluated the performance of the sector in 2019 as well as the impact that COVID-19 has had on the sector, the measures adopted, and the activities performed within SaSaD for our magazine.

**Defence Turkey: Dear Mr. BAYSAK, before commenting on the impact of the pandemic on the sector, can you take us through last year's numbers, taking a look at the metrics and graphical assessment of the Defense and Aerospace Industry's previous year results?**

**Hüseyin BAYSAK:** I suppose it would be better to start with good news. We have just completed the preparation of the Sector Performance Metrics of

2019 and a few days ago published them upon the approval of the Presidency of Defense Industries. Our sector seems to have had quite successful performance in 2019. We witnessed positive developments in almost all metrics. In brief, while our turnover reached US$ 10,884,081,347 with an increase of 24,3 % compared to the previous year, the Overseas Sales Revenue rose to US$ 3,068,519,809 with an increase of 40.21%, again compared to the previous year.

In addition to the Overseas Sales Revenue, there is a similar development also in the Sector's Exports. The exports reached the level of US$ 2,741,988,000 with an increase of 34.6% compared to the previous year. Meanwhile, an increase that was not at a similar level to the turnover was seen in imports and the imports amounted to US$ 3,088,465,82, an increase of 26.11%. In employment, an increase of 9.71% was achieved compared to the previous year and the number of employees in our sector reached 73,771.

Similar favorable developments were achieved in the product and technology development activities conducted in our sector as well. With an increase of 15.44% compared to 2018, the expenses in this group accumulated to US$ 1,672,052,468 and of this amount US$ 1,423,067,193 was spent in Product Development where Technology Development expenses reached US$ 248,985,275. 19.8% of the total Product Development and Technology Development expenditure that is US$ 331,291,055 is equity capital expenses (the expenses of the sector players financed by their equity capital). Compared to the previous year, there was a decrease by 12.56% in new orders received by the sector and the amount realized was US$ 10,671,519,679.

All these developments are pleasing, and we appreciate their value as they also signal the sustainability of the competence and capabilities acquired by the sector. We will be displaying these figures in a mathematical sense, presenting them in a detailed report with our added analyses and we will share them our stakeholders in the upcoming days.

**Defence Turkey: Turkish Defense Industry Exports were declared by TIM in December 2019 to have reached US$ 2.741 billion. What are the differences between the data you provided as SaSaD and the data declared by TIM?**

**Hüseyin BAYSAK:** As SaSaD we do not use the term 'exports', instead we refer them as Overseas Sales Revenue. The Defense and Aerospace Exporters' Association publishes the amount of the exports of the items that pass through customs and exports that remain within the customs tariff statistics position (HS Code) as the total amount of exports. But we add our sector players' engineering activities held abroad and foreign exchange generating services resulting from various support activities to the export figure and we define the total result as the Overseas Sales Revenue. As a result, the amount of our exports realized was US$ 2.742 billion. When we add around US$ 378 million in foreign exchange generating services that show decent progress to that figure, we obtain the figure of US$ 3.088 billion.

**Defence Turkey: Do you also include the data provided by Civil Aviation, MRO and Military Shipyards to the Foreign Exchange Generating Services?**

**Hüseyin BAYSAK:** When we combine these data, we include all the data on the activities conducted in defense, military and civil aviation, MRO (Sea, Air and Land) and homeland security as well.

**Defence Turkey: We observe that the data of imports and exports are almost in balance this year. What does the balance between Import and Export data mean?**

**Hüseyin BAYSAK:**: An increase of 34.6% was achieved in exports, where it had risen to the level of 18-19% in the previous years. 2019 was a fruitful year. Regarding imports, the indigenization efforts regarding certain import items as part of the indigenization and nationalization activities launched by the Presidency of Defense Industries are demonstrating a positive effective. Therefore, where the import/export coverage ratio was at the level of 80-90% in the previous years, this year we can say that this ratio reached nearly 100%.

**Defence Turkey: There is a substantial increase in R&D and Product Development expenses. What would you like to say on this issue?**

**Hüseyin BAYSAK:**The Turkish Defense Industry has been allocating a significant amount of resources to Technology and Product Development areas. These are conducted through projects supported by the state and the fund generated by the equity. Almost every year we observe an increase of around 15-18% compared to the prior year. Here we are speaking about an expense increase of almost 16-17% for Product Development and Technology Development

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|---|---|
| Total Sales | 10.884.081.347 $ |
| Overseas Sales Revenue | 3.068.519.809 $ |
| Import | 3.088.465.821 $ |
| R&D Expenditure | 1.672.052.468 $ |
| Number of Employees | 73.771 |

expenses, reaching an amount of US$ 1.6-1.7 billion within a turnover of approximately US$ 10 billion. The Gross Domestic Product consists of nearly 1% in R&D expenses. Resources at the level of 16-17% are being allocated to Product Development and Technology in Defense Industry.

**Defence Turkey: Mr. BAYSAK the figures shared in 2019 were at a promising level for our defense industry. However, a new era has begun with the pandemic in 2020. How has the COVID-19 impacted the Defense and Aerospace Industry? This unprecedented global crisis spans sectors, our local and the global economy and countries. What are your thoughts and assessments about the post-pandemic era?**

**Hüseyin BAYSAK:** The pandemic we have been going through has unfortunately started to affect our country as well since March 11th. A series of measures are being adopted and implemented by the state and the government in the fight against the outbreak as well as for the management of the crisis. As a result of these measures, the lockdown implemented in all countries has either completely or partially slowed down or either terminated the activities in numerous sectors, thus negatively affecting the economy. The Defense Industry is being regarded among the critical sectors in every country and almost all countries allow the operations to continue while placing great


importance on the health and safety of employees.

By placing the health of employees into the forefront, to protect them, our sector players designed some special procedures where the working methods and precautions were redefined, and they were put into practice. To this end, new working procedures were implemented. We prepared a survey to identify the new procedures implemented by our members, a survey on how they are managing their business during this period. We asked them certain questions and according to their responses we determined the following results:

- 6.82% of industrialists maintained their pre-crisis working procedures/processes,
- 9.09% of industrialists suspended operations at their facilities and launched a remote/ working from home model,
- 36.36% of industrialists conducted operations with certain employees on site continuing to operate at the facility as required by their position, while other employees continued work remotely/ from home,
- 13.64 % of industrialists grouped their existing personnel into shifts/ teams, decreasing employee density by modifying shifts into a staggered schedule of 2-3 shifts,
- 31% of industrialists implemented all the aforementioned steps, while just 2% of industrialists suspended all their operations for the first two weeks.

Consequently, the sector players continued their activities during the normal days and the lockdown days with the privilege granted by our state. During the last two weekends and the last 4-day lockdown (April 23 National Sovereignty and Children's Day), we enabled our stakeholders to carry out their activities through special permits. Nevertheless, as a result of the conditions set by the process and the anxiety among employees, we have witnessed a loss in efficiency and we observe that the output of the activities is below the expected level or the level we are accustomed to. Based on such observations, we designed a survey composed of 25 questions where we included the detections and suggestions of our stakeholders on the impacts of the pandemic and on ways to minimize these impacts and we shared the study with all the relevant authorities (Presidency of Defense Industries, Ministry of National Defense, Ministry of Treasury and Finance, Ministry of the Interior, Ministry of Health and Ministry of Trade). We are pleased to see that most of our suggestions were in the announced support package as well as in the decisions taken by our Presidency, our Ministry of Treasury and Finance, Ministries of Health and Interior and Governorships. In respect of fulfilling the requirements of the healthcare institutions during the pandemic, especially regarding the production of special personal protective equipment, our sector players generated solutions by utilizing their existing engineering and design infrastructures and production infrastructures. Witnessing such efforts pleased us on behalf of the representatives of the sector and I would like to state that this is certainly a gratifying development for our country.

In the previous years, we launched a study with Hacettepe Teknokent to find out how Healthcare, Defense and Information Industries could cooperate. For instance, there is a significant amount of foreign currency expenses regarding medical equipment in the healthcare sector. It was determined that the know-how and infrastructure accumulated in the Defense and Information Technology Sectors were at the level to fulfil many

requirements. In the Capability/Competence and Requirements matrix prepared on this subject, it was determined that much of the equipment that is being imported could be manufactured in our country. Unfortunately, this project remained incomplete after the first stage. However, some of our members that took part in the aforementioned project, witnessed that they had very significant and important infrastructures, concerning in particular imaging devices, surgery and laboratory equipment. From this perspective, we placed and prioritized the medical devices from neighboring sectors in our sector's sustainability strategy. The Medical Imaging Devices of Aselsan are a good example of this. One of our members, Nanobiz conducted critical activities for the Coronavirus diagnostic tool. They have reached the clinical trial stage. Biyosis, Dora Makine, Arçelik and Bayraktar are also conducting activities on respiratory devices. We may refer to these endeavors as examples of where the know-how and infrastructure of the defense industry are utilized.

A brief look at the state aid packages launched by various countries in the world is provided in the figures below:

- Countries allocated the following: The U.S. US$ 2 trillion, Japan US$ 988 billion, Germany € 750 billion, Italy € 400 billion, United Kingdom £ 81 billion, Switzerland US$ 43 billion and Israel US$ 22 billion. Turkey declared its support package in this period as US$ 14.5 billion (with the additional support the total amount reached US$ 30 billion).
- 30% of the support package announced by the U.S. is allocated to individuals, families, 25% is to Major Companies, 19% is to SMEs, 17% is granted to Local Administrations and 9% is allocated to Public/Healthcare services.

Though the breakdown is not known yet in our country, it is possible to mention that there is a similar breakdown based on supported groups. Since our sector players are carrying out their operations in some way, they feel the impact of the pandemic at a lower level, for instance less than in the civil aviation and tourism sectors, especially in domestic orders received and their domestic activities. However, when we look at the interaction with foreign countries, the initial data reveals that this interaction would be lower. The study conducted by TIM reveals a 49.8% reduction in Defense Industry's exports from 1 January 2020 - 31 March 2020, compared to the same period the previous year. This study reveals a deeper decline from 23 March - 31 March, plunging to a decline of 57.2%. These percentages are higher than Turkey's average and thus they should be regarded as signals for potential setbacks to be experienced in the upcoming period in terms of exports. We have to pay utmost attention to this area.

**Defence Turkey: We observe that potential losses may be experienced in defense industry exports. Could our defense industry companies, those that can add value and provide equipment needed by foreign countries, for the healthcare industry for example, offset these export losses?**

**Hüseyin BAYSAK:** It will compensate for the losses to a certain extent. From now on, the healthcare industry will remain in the forefront within the priorities to be identified by the states in the utilization of resources. The food sector will stand out similarly. We presume that the Defense Industry will slightly recede, and this will pave the way to a certain amount of regression in defense industry exports. We need to explore ways to replace this. One option will be the healthcare sector, which remains among the priority areas. We will need to build upon the serious potential in producing healthcare equipment, medical devices (medical imaging devices), laboratory - surgery equipment and export them. It will be difficult to reach a certain level of maturity in 2020 or in 2021 but we will be including the aforementioned products to the exports of the defense industry stakeholders.

I would like to proceed this interview with assessments in this area with excerpts from the document "Projections on the New Economic Order after COVID-19" prepared by the Aegean Region Chamber of Industry. The projections by Silicon Valley signal certain positive developments in terms of the working environment. Though, this research mentions that there would be certain negative impacts in terms of the economy and that businesses would progress slower than usual, what I find interesting is that Silicon Valley itself has a projection that Artificial Intelligence may cause calamity to humanity. They state that capitalism will end, and socialism will appear on the agenda and that universal basic income (UBI) will be discussed. Again, a more connected yet decentralized world is envisaged, it is foreseen that dependence upon other countries particularly in areas such as medicine, food and technology would be questioned and ways of gaining independence in such areas would be sought after. Moreover, the research includes that the industry and working methods would be altered and renewed, physical meetings that gather people would be minimized, while working from home and telecommuting methods would become popular. The research contains a finding that in this period, companies that implemented telecommuting experienced an increase in efficiency. It is believed that a comfortable working environment and better concentration will pave the way to the extension of remote work models.

The assessments made by the leaders imply the following:

- Expense priorities will shift, and new priorities will be defined,

*Hüseyin BAYSAK - SaSaD General Secretary*

- The nation state concept and nationalist tendencies will grow stronger,
- Multiple step supply chains involving multiple countries will change and shrink, and a return to national resources will occur,
- The axis of power will shift towards the People's Republic of China and Asia, which will achieve an earlier recovery in terms of social and economic aspects,
- Long-term decreases will be experienced in business travel; promoting and marketing activities, contract negotiations will be conducted online without travel,
- The budget allocated to healthcare services will increase and technology companies will conduct intense activities on innovation and creative applications.

From this point of view, it is likely that the process ahead will not be very bright for the defense industry. In order to maintain and improve our current status, we need to carry out new activities.

Within this framework, if we take into consideration the shift in spending priorities of countries, meeting defense requirements will probably lag behind other priorities of many countries. Resources allocated to this area will be more limited. I believe that this case will signal a recession for our sector in terms of exports. Considering the prominence of medical requirements in priority areas, a new business area will emerge for our sector and we may regard this as an area that would cover for our losses. Besides, I believe that Cyber Security, Big Data and Industry 4.0 will be among the top priorities.

Based on issues such as isolation precautions and the protection of employees' health after the pandemic, it is very probable that instead of working in offices and conducting physical meetings, working from home will become widespread. As part of the preparations to be made in case of potential crises, we may project that the demand for automation and Industry 4.0 implementations will increase and in this way measures to decrease the number of employees onsite in the workplace will be adopted as well. There will be a long-term decrease in business travel and it will be replaced by online promotion activities and meetings. We can also say that the basis of global production will be hit hard, and nationalist tendencies will grow. Within this scope, supply chains with multiple steps and multiple countries will also be reevaluated. This method will diminish as individual countries become supported by governments as indigenization and nationalization efforts increase, paving the way for the emergence of a new area of business for our industrialists. A new stage where the supply chain will be executed remotely, including customers, will be opted for. We also must underline the view suggesting that profit margins may decrease while this system enables a more flexibility in the sector.

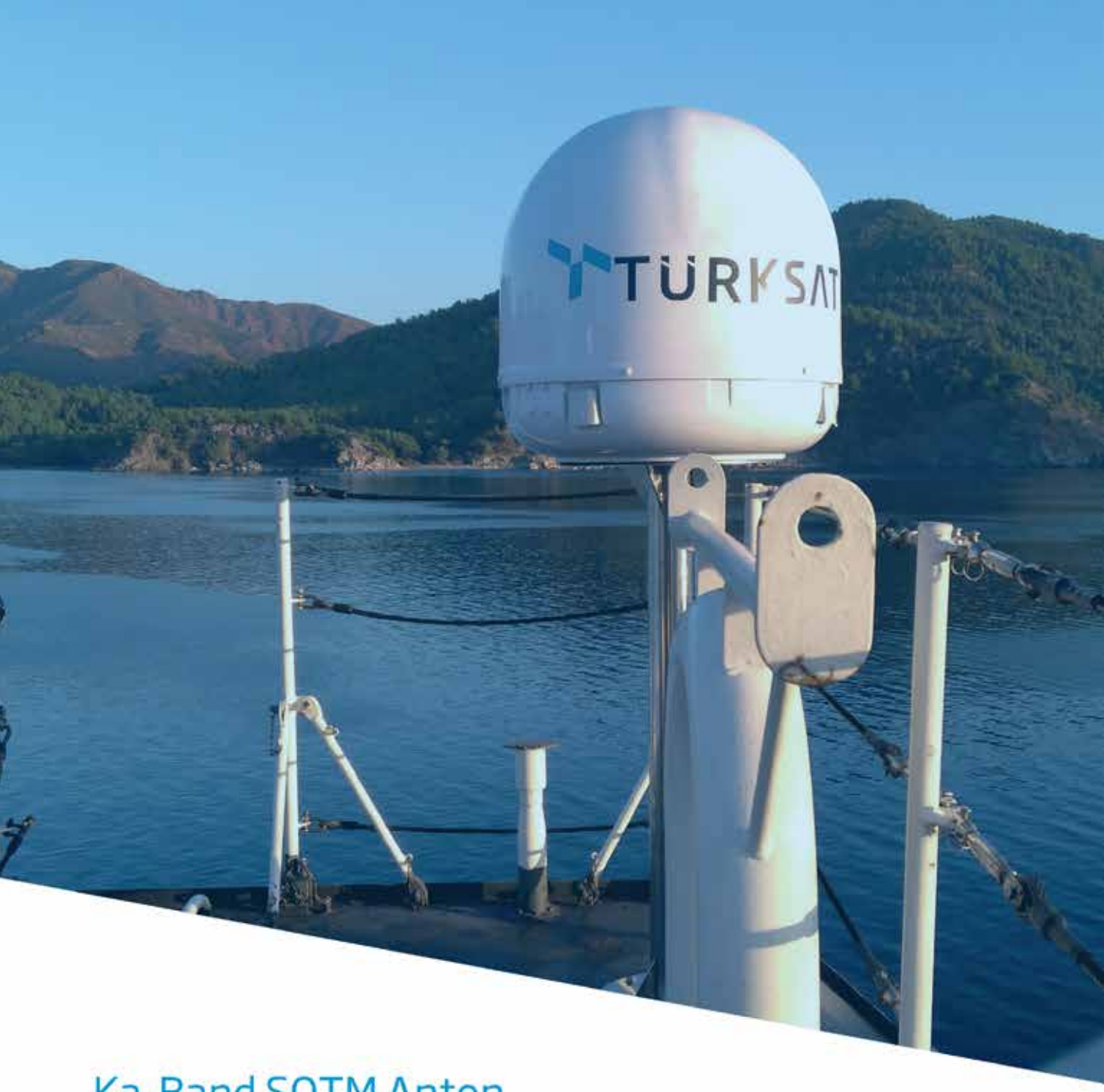
We can say at the end of the day that the future holds many political, economic and social novelties.

**Defence Turkey: Mr. BAYSAK, I believe it will be useful to remind our readers of when the Sector Performance Report covering the detailed breakdown will be announced. When will this report be published?**

**Hüseyin BAYSAK:** Our colleagues are preparing the graphics. Most probably we will have prepared the printed version of this report in mid-May and will be sharing it with our stakeholders.

**Defence Turkey: Mr. BAYSAK, thank you very much for this interview.**

**Hüseyin BAYSAK:** Our sector has quite competent human resources and a valuable product, design and development infrastructure. I expect to see the utilization of the infrastructure in a variety of different sectors, as we recently have demonstrated with the prioritization of producing medical devices. Moreover, when there is a setback in the other sectors such as transportation, automotive and energy, our sector could be directed towards these neighboring industries to support them. I am quite confident that our sector will be maintaining its dynamism and sustainability. Thank you...

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# Turkish Defense Industry Positioned to Weather the Storm with Cross Sector Collaboration

The President of TOBB Defense Industry Council, Yılmaz KÜÇÜKSEYHAN evaluates how the COVID-19 pandemic has impacted defense industry companies from the outset of the outbreak and what precautions decision makers have implemented to help businesses come out of this crisis unscathed.

**Defence Turkey: Mr. KÜÇÜKSEYHAN, thank you so much for meeting with us in this video interview as we all are working remotely these days. We see that the defense industry is also affected by this process. You closely follow the problems that have arisen in the sector with industry stakeholders and establish the necessary coordination. How has the COVID-19 pandemic impacted our companies? What kind of cooperation has been established within the sector regarding supply processes, supports/aids and coordination?**

**Yılmaz KÜÇÜKSEYHAN:** I regard the COVID-19 outbreak as a hot war, because when you examine the history, you cannot see a war with so many casualties in the world at the same time. For this reason, we are under harsh combat conditions. It is impracticable to claim that the defense industry, which is the critical and solid part of the economy, is not affected by this pandemic. Considering the ecosystem as a whole, the impact on the defense industry has been relatively minor when compared to other sectors. Despite all the embargoes imposed, and the countries that opposed the Peace operations that we conducted in Syria and Iraq in 2019, I consider the 2019 figures as a very pleasing picture. This is an indicator of the sector's discipline, and the tremendous systematic efforts exerted. I would like to thank all the contributors and colleagues.

I asked small, medium and large-scale companies that I know "How has this virus affected you?", the answers I received from them in general are that "the companies with strong financial structures will continue this momentum also in 2020". Despite the damage the economy has been suffering, they think this momentum will continue. However, in exports, some disruptions will be observed in the defense industry as countries shift a large part of their budget allocations to pandemic expenditures due to this outbreak.

While our domestic needs continue to be covered to a large extent, we also feel the joy and pride of having accomplished overseas sales amounting to more than US$ 3 billion in 2019. Our export figure for 2019, which was calculated by the Defense and Aerospace Industry Exporters' Association as per the customs declaration forms, was US$ 2.732 billion. When we add these figures, the activities such as maintenance, repair and modernization performed abroad, which we call foreign exchange earning

services, a total of US$ 3.088 billion in overseas sales revenue was achieved.

The industry is confident that it will maintain its current status in 2020 with the momentum that it received in 2019. If the government continues to increase the incentives that it has made so far to companies and institutions with weak or weakened financial structures, and which are indispensable, we will certainly be able to escape unharmed from this process as an industry. All 2020 budgets were prepared and allocations were made accordingly. If such allocations are not shifted to the health sector in our country, and if the resources allocated to the Defense Industry are not directed to healthcare sector also in foreign countries, I believe our exports will increase once again. Of course, timely payments are also a very critical factor here.

**Defence Turkey: Mr. KÜÇÜKSEYHAN, we observe that the civil aviation sector took a monumental hit during this process. As you mentioned, one of the most important elements here is the sustainability of companies, and the effective management of cash inflow and outflow to survive. In this process, cash outflow is restricted due to insufficient cash inflow. Small-to-medium companies need resources to sustain their cash flow to survive. Will the TOBB Defense Industry Council provide recommendations to the decision makers regarding separate loan facilities for companies or amendments to provisions on existing loans?**

**Yılmaz KÜÇÜKSEYHAN:** This is an issue that we have focused on for years; there are companies with weak financial structures and are entering the Defense Industry with great eagerness. While registering our members to SASAD and TOBB Defense Industry Council, we determine their financial structure and capabilities both after consulting with the relevant parties and visiting the companies. 98% of our members are financially sound companies that meet the required criteria. What will disrupt the structure of these companies are the delays in delivery. If these delays are caused by payments from the government, this may cause trouble. A budget of US$ 1 million or a delay may not a big deal for our companies such as Aselsan, Roketsan or FNSS, but for an SME employing 5-6 staff, this is perhaps an amount to cover its 1-year personnel expenses. I have interviewed a few big companies these days and I have seen a lot of examples here. For example firm A said that up to now, they have made US$ 400 million in payments to its subcontractors without delay. Our Defense Industrialists are not going through any difficulties in obtaining credit, including small and medium-sized companies. The point we need to pay attention to is that the force majeure clause must be included in the contracts. There may be wars, or something else may happen, I cannot think of anything greater than the pandemic, so all such conditions have to be added to the contracts as a force majeure event.

Our request in this process is to postpone the immediate and binding delivery dates of the main contractors from this time forth if we want to proceed successfully in 2020. For example, there may be products or materials that needed to be delivered in March, but our SMEs or sub-industry companies should not be imposed penalties for not fulfilling this condition. It should be postponed for at least 6 months. It is necessary to use a clause that will explicitly cover what the force majeure might be, either within the contract or in other binding documents. As of today, this should be taken into consideration for prospective contracts, I think that our state is probably going out to international tenders and signing contracts by taking such force majeure events into consideration. We must do the same. We will postpone the deliveries and we will not impose penalties to our companies.

**Defence Turkey: We see that our companies are not affected in terms of employment; on the contrary the main contractors have increased their employment numbers. What are your views and comments on increasing employment in 2020 or maintaining current employment?**

**Yılmaz KÜÇÜKSEYHAN:** This year, our employment increased from 63 thousand to about 73 thousand, including the employees in subcontractor companies. As can be seen, our employment number is quite high. But we do not include the number of employees in subcontractor companies; we only consider the number of permanent staff. To give an example, Turkish Aerospace (TUSAŞ) recruited 2,000 personnel for new projects last year, and our other large companies employed around 1,000 staff each, maybe a little more. SaSaD Secretary General Hüseyin BAYSAK provided you with the figures about the activities carried out by our companies in the form of remote working, shift working or uninterrupted working due to this pandemic. Some of our companies, which I like the most among these figures, have not changed their working orders. Members of the board, who are 65 years old and above, participated in management by teleconference. As an industry, I do not think there will be any layoffs next year; on the contrary we may have the chance to include the talent that is laid-off in other sectors and bring them into our sector. It could be a chemical engineer or a mechanical engineer, and we are able to add them all to our permanent staff. We managed to bring Turkey some research assistants from abroad, those doing their doctoral studies abroad, or the qualified personnel who are working in foreign countries for a certain period of time. At least 10% of those want to stay in Turkey, and it will be a great opportunity for us. We need to employ these colleagues in relevant positions as per their talents, with the support of the state. I expect an increase in employment as an industry; I do not expect any decrease.


**Defence Turkey: We observe that the Turkish Defense Industry has taken protection measures for its employees. Unfortunately, it is reported that there may be mass layoffs in multinational companies around the world. In your opinion, should there be any effort exerted during this period for the utilization of the related qualified workforce here in Turkey?**

**Yılmaz KÜÇÜKSEYHAN:** As it is known, we carry out activities for the prevention of brain drain. This is an issue that our Presidency of Defense Industries has been working on for 1-2 years. As a person who has led this team for a while, I see this period as an opportunity. While we were doing surveys before, none of them were willing to give details on where they were working, but now it is clear, where they are working is known. It may be possible to reverse the brain drain, if the talents of these colleagues are examined and followed up with face-to-face talks to share details with them about the opportunities to be provided by the state. Thus, a qualified workforce can be achieved. We should take the steps now, so that before the virus crisis ends and before everyone goes back to normal working order, specific and immediate action should be taken so that we do not send out our talented and qualified people abroad again.

**Defence Turkey: During this period, it is said that some countries will move toward restrictions in Defense Industry expenditures. However, every crisis also brings new opportunity, and it has been reported that diverse developments in the healthcare industry or technology sector will occur. In your opinion, can Turkey create a roadmap with the defense industry, with particularly high added value and a strong infrastructure, in order to turn this crisis into an opportunity?**

**Yılmaz KÜÇÜKSEYHAN:** In 2014-2015, while I was performing as an audit arbitrator for the R&D centers of the Ministry of Industry and Technology, Aselsan had 5-6 R&D centers. If I had not know that it was Aselsan, I would have thought that it was an R&D center owned by the Ministry of Health. I knew the high costs of the sensor-based detection devices coming from abroad, and the activities they performed in those days made me very happy and I thanked them. The Defense Industry has a creative power. Thanks to that, for example, regarding the production of respiratory devices, Aselsan's General Manager told me that their activities were continuing. These are the opportunities that lie in the crisis. The Defense Industry has a sound and very effective technological infrastructure. I think this infrastructure, within the framework of the ecosystem, has the required technology and knowhow in almost all aspects of the economy, from agriculture to production, from rail systems to meeting the needs of hospitals. I audited more than 50 R&D centers, personally interviewed nearly 1,000 researchers and closely witnessed the potential. We need to take advantage of this opportunity.

On the other hand, with the last decree, a 20% additional tax was imposed on goods imported from the U.S. For the previously awarded contracts regarding the import of products, especially regarding foreign-dependent products such as raw materials and semi-finished products, there are situations where we cannot reflect this increase in prices as an increase in customs duties. Therefore, we think that it would be appropriate to withdraw this tax increase; doing so would result in a concrete benefit to our companies, otherwise this 20% additional tax will be incurred as the company's loss.

**Defence Turkey: Nowadays, when land borders and airspaces are closed, there are difficulties in importing materials and equipment or exporting. What problems have been raised to the TOBB Defense Industry Council in this area? What have sector stakeholders shared with you about shipping exported and imported products by air, land and sea? What needs to be done to solve these problems?**

**Yılmaz KÜÇÜKSEYHAN:** Countries producing and selling oil have suffered greatly by this crisis. We have never seen such a low price before. In air transport, the suspension, restriction of international travel or the option to conduct flights with special permits will cause cargo transportation to be at the top of the agenda as a separate issue in the future. So far, no problem has been reported to us, there were some problems such as customs issues, but these were related with land or sea transportation. I suppose that air cargo transportation will come to the fore in the future, the deepest need for this was seen during this period. In the next 5-6 months, we will see airlines continue to conduct cargo transportation rather than passenger transportation. Turkish Airlines has already started using passenger aircraft in cargo transportation.

**Defence Turkey: Turkey as well as the whole world is going through a challenging crucial time and I think your precious words will guide many of us in this process. I hope our country will weather this storm and come out ahead. Thank you so much for your time**

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# OSSA Chairman of the Board Mithat ERTUĞ: "During the COVID-19 Pandemic, the Turnover of Our Companies Decreased by 30-40%"

In a video interview held on May 4th, OSSA Chairman of the Board Mithat ERTUĞ and Defence Turkey Magazine Managing Editor Cem AKALIN discuss the COVID-19 measures taken by OSSA cluster companies; these companies who form the backbone of the Defense Industry, updates on the latest status of production activities, and insight into the expectations of industry decision-makers

OSSA membership reached 255 in 2019 with the participation of 39 new members, and members have continued their work with 2-3 split shifts during the pandemic. Chairman of the OSSA Mithat ERTUĞ stated that OSSA cluster members have been acting in a credible manner since the beginning of the pandemic, companies have supported each other in every aspect, showed solidarity, and that all companies followed the 14 rules set by the Ministry of Health. ERTUĞ: "They applied all rules strictly, from measuring body temperature, using disinfectants to social distancing. Fortunately, there has not been a single reported case in OSSA member companies so far. Many companies have camera systems and we follow this process closely."

## ERTUĞ: "30-40% Decreases Occurred in Turnover During This Process"

Companies have reduced their day shifts and increased their night shifts within the framework of the measures taken. ERTUĞ said, "Of course, there are some delays in activities due to the social distancing rules, but we have increased our working hours in order not to leave our main contractor companies in a tight spot. We have increased our number of employees in the night shift and reduced the day shift. But during this period, 30-40% decreases occurred in turnover."

Stating that companies were striving to take advantage of loans offered by public banks in this process, ERTUĞ said that the companies were making critical investments and commitments in the aviation sector before the crisis and that they were caught napping by this

pandemic under a high investment period. ERTUĞ: "This put us in a tight spot. We had borrowed money for our huge investments, and when this outbreak occurred, our companies especially performing activities in the field of aviation got into trouble. Foreign demand dropped. When Airbus-Boeing orders decreased, this also affected us. We do not know what awaits us in the days ahead, but my continual advice to our companies is that doing business in one sector would be challenging. We need to add a few more sectors to our companies' fields of activity. In the upcoming period, I think some of our companies will appear in the medical industry with their products. Our cluster companies may engage in both the energy and health sectors."

## ERTUĞ: "We are Waiting for a Rise in Demand"

Underlining that they are able to provide support to the healthcare sector if a demand occurs, ERTUĞ said, "Our companies are capable of meeting demands when they arise. We share them with the Technoparks, other clusters and large companies. One of our companies produces the components of a respiratory device. There is significant infrastructure in all our cluster companies. It is absolutely possible to develop and produce these products here. So far, we have not received any requests. No specific demand has been made for a mask or a ventilator device. For example, one of our OSSA companies manufactures machines that make masks. The components of this machine are again produced by our cluster companies. If requested, we can take all relevant actions."

OSSA's aim is to increase the competencies of the companies and to certify them. ERTUĞ shared that they have achieved this up until now and added: "We created this eco-system within 15-20 years. Specialization is quite important; you have to focus on a single sector. We are concerned about losing some of our areas of expertise due to this crisis. We are currently trying to protect our workforce. The aviation industry has shrunk sharply, so we think about how we can manage in the next few months. There will surely be a shift to other sectors to survive. Hopefully we will not lose this area of expertise."

ERTUĞ: "We were at the top of the List with 5,700 Bilateral Business Negotiations at the ICDDA event. We may Postpone the Event for 1-2 Months as per Feedback Suggestions. We are already Making all Our Preparations."

ERTUĞ provided information on whether or not the Industrial Cooperation Days in Defense and Aerospace


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(ICDDA), (planned to be held for the fifth time on 13-15 October 2020 this year) will be postponed and said that the delay is not on the agenda at the moment, but alternative plans are discussed in parallel. ERTUĞ: "In the previous event, we were at the top of the list with 5,700 bilateral business negotiations. We wanted to raise the bar even higher this year. Our number of participants is also very high, but this pandemic has emerged. We are working on solutions to host our guests coming from abroad. Even if the restrictions are lifted or eased in the coming days, we will definitely follow the 14-day quarantine rule. Even if we cannot bring our foreign guests here, we can hold these talks in a digital environment. We are making preparations for the necessary infrastructure. The situation will be finalized in June-July. According to the feedback to be received from abroad, we may delay the event for 1-2 months. We will evaluate this again in coordination with officials from abroad."

In the closing of the interview, ERTUĞ emphasized that the support given to investors is very important. He stated: "While Turkey's export per kg was US$ 1.32, defense and aerospace/ aviation industry export per kg reached US$ 46.59. The rate of return of the defense and aerospace/ aviation industry investments to our economy is achieved in the long term, but with higher added value compared to other sectors. Therefore, continuing investments in this area without slowing down is quite important for the economic growth. We would like to thank all our high-level officials and authorities for their support to industrialists in this field" ■


# The F-16's Evolution from a Lightweight Day Fighter to a Deep Strike Aircraft

by Cem DOĞUT

In 1968, the United States started a new aircraft project following the development of the high-performance interceptor Mig-25 by the Soviet Union. The requirements of the F-X project were 40,000 lb. MTOW, a maximum speed of 2.5 Mach, and a high thrust-to-weight ratio. In 1969, McDonnell-Douglas's F-15 was selected, leading the way to the birth of the fighter that would replace the F-4 Phantom II. It carried a powerful radar (APG-63) and plenty of missiles (4 AIM-7 and 4 AIM-9) to deal with the Mig-25. As the F-X project continued, the challenges of equipping the Air Force with such a capable and expensive aircraft began to arise. The team that led the debate was nicknamed the "Fighter Mafia" at the time. The core staff of this team was Colonel John Boyd, Colonel Everest Riccioni, Analyst Pierre Spray, and Engineer Harry Hillaker. The Fighter Mafia believed that the ideal fighter should be light and highly maneuverable. Thus, it could easily change its speed, altitude, and direction. Also, it would be difficult to detect the light and, therefore, the small plane. It would also be cheap to manufacture and operate. Later, Boyd and his team received funding from Northrop and General Dynamics to develop these concepts. The Air Force did not support these efforts, as it would undermine the F-15 (Project F-X). Finally, they realized that the budget would not be enough to get enough F-15s and then the Fighter Mafia's ideas started to be valued. The Advanced Day Fighter concept emerged and was named the F-XX project. With the support of the Department of Defense, the Air Force Prototype Study Group was established in May 1971. Two of the six candidates were selected, and the Lightweight Fighter (LWF) project was initiated. The request for proposal was published on June 6, 1972. In light of the lessons learned from the Vietnam War, the Six-day War, and the Indo-Pakistan conflicts, the USAF requested a fast and high maneuverable aircraft that weighs 20 tons and is optimized for combat at Mach 0.6 - 1.6 at an altitude of 30,000 - 40,000 feet. In May 1972, the proposals of General Dynamics and Northrop were selected, and the YF-16 and YF-17 prototypes were manufactured. The prototypes made their maiden flights on February 2, 1974, and June 9, 1974, respectively. That same year, NATO members Belgium, Denmark, the Netherlands, and Norway wanted to replace their F-104Gs. The winner of the LWF project would also have the opportunity to be sold to these countries when the U.S. Air Force's desire to replace its F-4 and F-105 aircraft, combined with these countries' need for a new fighter-bomber, the LWF project turned into the Air Combat Fighter (ACF). The YF-16 aircraft had also evolved into a multi-role fighter from a day fighter, and the number of its underwing pylons was increased from two to three. The radar requirements were also changed, and the Westinghouse APG-66 multi-mode mission radar was selected.

On June 13, 1975, the U.S. Air Force announced that it had chosen the YF-16. In this choice, the P&W F100 turbofan engines used in the F-15 aircraft played a significant role as much as the YF-16's superior acceleration, climbing, and maneuverability to the YF-17. This selection also reduced engine unit costs and operating costs.

In the 1970s, the Fighter Mafia's ideas became a reality thanks to engineers in Fort Worth, Texas. The resulting lightweight fighter incorporated various advanced technologies that were not previously used in operational aircraft. A LERX (leading-edge root extension), which is a small extension to an aircraft

wing surface, was added forward of the leading edge to improve the airflow at high angles of attack and low airspeeds. Additionally, the aircraft's response time was reduced by using the fly-by-wire system instead of the heavier hydraulic system. The YF-16 is the first aircraft designed and manufactured to be aerodynamically unstable. This characteristic, which is also known as Relaxed Static Stability, increases the agility of the plane. By its very nature, a stable aircraft wants to switch to a level flight if its controls are released. This is called Positive Static Stability. RSS planes require numerous control inputs or trim changes to fly. On the other hand, these momentary changes are executed by the F-16's onboard computer, which is integrated into the fly-by-wire system to ensure that the aircraft flies properly. The ejection seat reclined 30 degrees from vertical to reduce the effect of g-forces on the pilot. The plane also features a side-mounted control stick to ease control while maneuvering. With the HOTAS, HUD, and the bubble canopy, the pilot's situational awareness was increased. All these technologies had been tried in some aircraft and research programs before. But with the YF-16, it was the first time that all elements came together on a production aircraft.

The LWF planes were designed to have high maneuverability; however, they had to grow when they were converted to ACF. Their


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*YF-16, the prototype to the F-16 Fighting Falcon, flies an aerial refueling mission in March of 1975*

capabilities started to be increased during Full Scale Development (FSD). The number of pylons was increased from five to nine. By mid-1975, the aircraft's size and weight increased with new capabilities. Almost two years after winning the ACF competition, the first F-16A aircraft manufactured by General Dynamics made its first flight on December 8, 1976, followed by the F-16B in August 1977. Unlike Soviet aircraft, the two-seat F-16B had full combat capability, and both the F-16A and B had the same dimensions. The only difference was that the B models had approximately 17% less internal fuel capacity. Internal fuel capacity was lowered for the rear cockpit.

The USAF decided to buy 650 F-16s in the late 1970s. On June 7, 1975, four European partner countries (Belgium, Denmark, the Netherlands, and Norway), now known as the European Accession Group, ordered 348 F-16As/Bs at the Paris Air Show for US$2,168 billion. Described as the sale of the century, this order was split among the European Participation Air Force (EPAF) as 116 F-16s for Belgium, 58 for Denmark, 102 for the Netherlands, and 72 for Norway. As part of this process, two production lines were established in Europe, one at the Fokker Schiphol-Oost plant in the Netherlands, and the other at SABCA's Gosselies plant in Belgium.

Starting from the initial design phase, the F-16 gained new capabilities over time. All significant changes on the F-16 fighters are displayed in Block numbers. As the block number increases, the aircraft's capabilities also increase. During its development, the F-16 gradually became heavier as if mocking its original production purpose and turned into a multirole fighter aircraft. More than 4,500 planes were manufactured under eight main models in 139 different configurations and were used by 29 countries. More than 3,000 operational F-16s are in service today in 25 countries. The first two YF-16 prototypes and eight Full-Scale Development (FSD) aircraft did not receive block numbers. These planes are called Block 0. Let's examine the development of the aircraft over time by taking a look at the notable blocks of the F-16.

## F-16A/B Block 1, 5 and 10

After the prototype and FSD programs, the first Block 1 F-16 (78-0001) flew for the first time on August 16, 1978 and was delivered to the U.S. Air Force that same month. Most Block 1 and Block 5 aircraft were upgraded to Block 10 in 1982 under the Pacer Loft program. The new production Block 10 aircraft (312 in total) was manufactured until 1980. The differences between these early F-16 versions were relatively small. The Pratt & Whitney F100-PW-200 afterburning turbofan engine was used in the aircraft. It has a thrust of 12,240lb (dry thrust) and 23,830lb (129.7 kN) with afterburner. Starting with Block 1, all F-16s were equipped with the ACES II ejection seat. The Tactical Air Command officially named the F-16A the Fighting Falcon, but its pilots and crews commonly used Viper because it was quick, agile, and very deadly.

## F-16A/B Block 15

The production of 983 Block 15s were manufactured in three production lines (America, Belgium, Netherlands) and spanned over fourteen years. Block 15s are the most produced model among F-16 aircraft. Many of them still fly in various Air Forces around the world. Its vertical stabilizer is 30% larger. This is the most apparent difference between Block 15 and

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*Pakistani Air Force F-16B (MLU) during the Anatolian Eagle exercise*

previous F-16 versions. The larger tail provides better balance and control, especially at higher attack angles. Block 15s gained new abilities with an Operational Capability Upgrade (OCU) such as the data transfer unit, the radar altimeter, the WAR (Wide Angle Reflective) HUD (Head-Up Display), the advanced Westinghouse AN/APG-66(V)2 radar with "track while-scan" mode and AIM-7 Sparrow and AIM-120 launch capability. One of the most significant improvements was the Pratt & Whitney F100-PW-220 engine, which was more powerful and reliable.

## F-16A Block 15 ADF (AIR DEFENSE FIGHTER)

The ADF program was initiated to protect United States airspace and to replace the aging F-4 and F-106 aircraft. For air-to-air combat missions, the F-16A Block 15 OCU aircraft were equipped with additional systems, including the AN/APG-66A radar. The radar can provide continuous-wave illumination for beyond visual range missiles like the AIM-7 Sparrow. It also features improved small target detection and "look-down, shoot-down" capabilities. Block 15 aircraft were also equipped with the AN/APX-109 IFF transponder, AN/ARC-220 High-Frequency (HF) Airborne Radio Set, and a 150,000-candlepower spotlight fitted forward and below the cockpit. From the late 1980s to the early 1990s, 271 Block 15 aircraft were converted to ADF.

## F-16A/B Block 20

Produced for the Taiwan Air Force (Republic of China Air Force) these aircraft, actually, are identical to Block 50/52 in capability. This was a purely political classification which aimed to avoid problems with China.

## F-16AM/BM MLU

The top five F-16 user countries (Belgium, Denmark, Netherlands, Norway, and the United States) decided to modernize the avionics and improve their aircraft's structural integrity. Thus, the MLU (Mid Life Update) program started. With the "Falcon Up" program, the service life is extended to 8,000 hours. The most critical element of the MLU package is the Modular Mission Computer (MMC). The new computer's processing speed is 740 times faster than the old computer in the original F-16, and it has more than 180 times the memory. Other changes that came with the MLU included wide-angle HUD, full-color multifunction displays (MFD), Integrated Control Panel (ICP which are the buttons below the HUD), ring laser gyroscope (RLG) inertial navigation system (INS), miniaturized GPS receivers, Digital Terrain System (DTS), improved data modems, and the AN/APX-113 Advanced Identification Friend-or-Foe system (AIFF) transponder. The cockpit lights were made compatible with night vision systems. Helmet-Mounted Display (HMD) was also added to the aircraft. An Electronic Warfare Management System (EWMS) developed by the Danish defense and aerospace manufacturer Terma Elektronik A/S controls the entire EW package, including the radar warning receiver (RWR), electronic countermeasure (ECM) pods and advanced chaff/flare dispensers. Portugal, Jordan, and Pakistan later joined the MLU program.

## F-16 C/D Block 25

The C/D models represent the second generation of F-16 planes. The fuselage is mostly the same. The most notable visual difference is the triangular-shaped part under the vertical stabilizer. This piece was enlarged in C/D models to accommodate the new communications antenna. Other changes include an improved fire control computer, an inertial navigation system (INS), multifunction displays (MFD), a new data transfer unit, a radar altimeter, and a jam-resistant UHF radio. The most significant change in C/Ds was the radar. The new AN/APG-68 radar offered greater range, anti-jamming capability, increased target resolution, and new operating modes.

## F-16 C/D Block 30/32

The first F-16C Block 30/32 model flew on June 12, 1986. The most notable change in this block was the introduction of an

alternative engine to the Pratt & Whitney F100. The General Electric F110-GE-100 started to be offered as a new engine alternative. The reason for this was to prevent PW from becoming a monopoly and to get better prices for the engines. The problems experienced in the first F100 engines were the most crucial reason behind this decision. Later, the Alternative Fighter Engine (AFE) program (also known as "The Great Engine War") was initiated. Now, two companies would compete to provide engines for the next blocks. If the Block number of the F-16 ends with "0" it indicates that it has a GE engine while "2" indicates that it has a PW engine. Block 30/32 was planned to have a common engine bay that accepts both engines. But in reality, that's not what happened, as a modification kit was needed to change the engines. Another situation that prevented the removal of the PW engine and the installation of the GE engine was the production of larger air intake for F-16 aircraft using GE engines. The large air intake is called the Modular Common Intake Duct (MCID) or bigmouth. MCID allows the GE engine to deliver full thrust even at low airspeeds. Additionally, radar warning receiver (RWR) antennas were installed on the leading-edge flaps. The previous blocks were also fitted with these antennas later.

The F-16N model produced for the U.S. Navy was a variant of the F-16C Block 30. It was powered by the GE F110-GE-100 engine and had a Normal Shock Inlet (NSI) like the early production Block 30s. The F-16N was also equipped with the AN/PG-66 radar, as in the F-16A models. There were also minor structural differences to meet the Navy's requirements. The plane lacked an internal 20mm cannon. Twenty-two F-16N and four TF-16N were produced from 1987 to 1988. The aircraft flew at the Navy Fighter Weapons School (Top Gun).

*USAFE (United States Air Forces in Europe) F-16C Block 50 with HARM Targeting System (HTS)*

## F-16 C/D Block 40/42

With Block 40/42, the F-16 gained night/all-weather navigation and precision attack capabilities. Original analog flight controls were replaced with digital flight controls. The flight control system controls the aircraft digitally together with other avionics in the plane. This feature enabled the integration of the LANTIRN pods to the aircraft. Block 40/42 also introduced more capable AN/APG-68(V)3 or AN/APG-68(V)5 radar (depending on the user) and the new WAR (Wide Angle Reflective) HUD which is compatible with LANTIRN (Wide Angle Reflective) system. Two additional stations (5R and 5L) were added under the air intake. Consisting of two pods, the AAQ-13 Navigation pod of the LANTIRN system is carried on 5L, while the AAQ-14 targeting pod is carried on 5R. The navigation pod contains a forward-looking infrared (FLIR) camera and terrain-following radar. The image from FLIR can be displayed on the HUD. This allows the pilots to fly the plane without night-vision goggles. Using the information from the terrain-following radar, digital flight controls can automatically fly the aircraft at the desired altitude, following the landforms. The targeting pod consists of a forward-looking infrared (FLIR) camera and a laser designator. Thanks to the FLIR, the target can be detected and tracked in all weather conditions, day or night. Additionally, the main landing gear was extended to increase the height of the aircraft, and larger wheels started to be used due to the increased weight. As a result, the landing-gear doors feature a slight bulge to accommodate larger diameter wheels. Moreover, the landing lights on the main landing gear in Block 30 and earlier models were moved to the front landing gear door due to the LANTIRN integration. Thanks to the structural improvements made in Block 40/42, the take-off weight increased from 37,500 lbs. to 42,300 lbs. and the weight limit during 9-g maneuvers increased from 26,900 lbs. to 28,500 lbs.

## F-16 C/D Block 50/52

With Block 50/52, F-16 fighters acquired AGM-88A HARM (High-speed Anti-Radiation Missiles) launch capability. Thus, the planes became capable of performing SEAD (Suppression of Enemy Air Defense) missions. The Block 50/52 planes use HARM missiles via the command launch computer interface. Additionally, the U.S. Air Force F-16s carry the HARM Targeting System (HTS). In this way, the location of enemy radars can be detected more precisely from longer distances. Block 50/52 jets are also equipped with AN/APG-68(V)5 or AN/APG-68(V)7 radars and advance IFF transponders.


*Israeli Air Force F-16D Barak aircraft is the first model to feature an ADS (Avionics Dorsal Spine). The ECM antenna is visible in the "drag chute" housing*

New munitions such as the AGM-84 Harpoon anti-ship guided missile and the AGM-154A/B Joint Stand-off Weapon (JSOW) were also introduced with this block upgrade. With the Block 50/52 Increased Performance Engines (IPE) program, Block 50s started to be powered by General Electric F110-GE-129 engines and Block 52s by Pratt & Whitney F100-PW-229 engines.

## F-16 C/D Block 50/52+ "Plus"

The 'Plus' upgrade improved the air-to-air and air-to-ground capabilities of Block 50 planes with the AN/APG-68(V)9 radar. With the new radar, the mean time between failure (MTBF) was reduced %50, and the range was extended %33. Thanks to the added SAR/GMTI feature, it can detect the target's location precisely and destroy it with GPS-guided JDAM. In SAR mode, it can provide images with a resolution of 91.44cm (3ft) from a range of 75km. The IFF system was replaced with the AN/APX-113 Advanced Identification Friend or Foe (AIFF) System with 185km range. The most obvious physical difference of the aircraft is the CFT (Conformal Fuel Tanks) added on the body and added on the ADS (Avionics Dorsal Spine) with D models. The aircraft can carry 450 gallons of extra fuel in its CFTs and still pull 9-g maneuvers. CFT provides an approximate 1,650km operational radius with an approximately 50% increase in internal fuel. This means around 40% more range than F-16s without the CFT. The primary purpose of the ADS is to increase the avionic carrying capacity, which was decreased due to the rear cockpit in D models. This allowed F-16 aircraft to carry ECM and communication systems that they had not been able to carry internally before. Thanks to the ADS, D models can also be used in non-training missions as they received the same avionics suite of the C models. Thanks to these features and the presence of a weapon system officer in the rear seat, Block 50+ Ds gained the long-range precision strike capability. Other users, primarily Israel, bought these planes specifically for this purpose.

## F-16I SUFA

Based on F-16D Block 52+, the maximum take-off weight of the F-16I was increased to 23,600kg, making it the heaviest Viper model ever produced. In the 1970s, the power-to-weight ratio of the original F-16A was 1.02, while in the F-16I, this ratio dropped to 0.56. While the power-weight ratio of the F-16, which was designed as a lightweight fighter at the beginning of the project, was above 1, this ratio started to decrease as the aircraft gained new abilities. This is the most apparent proof of the F-16's transformation into a multi-role fighter over time.

Roughly 50% of the F-16I's avionics are of Israeli origin. Elbit provided the mission computer, display processor, the advanced central interface unit, and the moving map display. Rafael provided the digital terrain system (DTS), central air data computer (CADC), data link, HF, VHF, and UHF band encrypted radio as well as multifunctional displays (MFD). While BAE Systems produced HUDs of the first 25 Sufa, the rest of the jets were equipped with Elbit EI-Op HUD-DU. All Sufa's have a HUD repeater in the rear cockpit, which allows information sharing between the weapon system officer in the rear seat and the pilot. Both crew members can use the Elbit DASH IV helmet-mounted display. The primary sensor of the F-16I is the AN/APG-68(V)9 radar. Radar data and moving map information are combined with Rafael DTS data, enabling safe flight at low altitudes by using terrain features. This sensor fusion allows flying under radar coverage. The Elisra active and passive self-protection system forms the center of the Electronic Warfare (EW) suite of the F-16I. The system uses optical IR sensors to detect the heat generated by incoming missiles. Unlike other F-16s, Sufa jets are equipped with eight chaff/flare dispensers.

## F-16 E/F Block 60

This version was developed to meet the UAE's need for a multi-role fighter with more air-to-ground strike capabilities.


*UAE Air Force F-16E Block 60 with Pylon Integrated Dispenser System (PIDS). The Block 60 features an AN/APG-80 AESA (Active Electronically Scanned Array) radar*

The aircraft needed to carry much heavier loads than standard F-16Cs and with an extended combat radius to reach Iran, which the UAE perceived as a threat. Based on the experience from the 1990-1991 Gulf War, more advanced sensors and systems were needed for self-protection and to carry out precision strikes, especially in adverse weather conditions. Deciding to invest in the new version of the F-16 to meet these needs, the UAE undertook the development costs of the aircraft. The contract for 80 aircraft, related equipment, and services (estimated to be US$6.4 billion) was signed in March 2000.

Since the structural integrity, avionics capability, and thrust power of the Block 60 configuration increased significantly; it received a new classification. The new generation Viper family F-16E/F was born. The UAE invested around US$3 billion for all the research and development costs of the Block 60.

Internally, Block 60 is a very different aircraft from the F-16C / D hull. The most critical system integrated on Block 60 is the AN/APG-80 AESA (Active Electronically Scanned Array) radar. The UAE became the first user of this new and revolutionary radar technology outside the USA. Compared to the mechanically scanned legacy radars, the stronger and more capable AN/APG-80 radar costs less to operate and maintain. The multifunctional (air-to-air, air-to-ground, terrain following, etc.) radar can continuously search and simultaneously track multiple targets. The AN/APG-80 can also generate high-resolution synthetic aperture radar (SAR) images. The installation of the AN/APG-80 and other avionic systems caused some structural changes. The pitot tube was removed from the front of the radome, and a new environmental control system (ECS) was installed for the avionics. New inlets and exhaust vents were placed in the tail section and under the fuselage to provide airflow for the ECS.

Other equipment specific to Block 60 includes the Northrop Grumman AN/AAQ-32 Internal FLIR Targeting System (IFTS) derived from the AN/AAQ-28 Litening. The system projects a view of where the aircraft is going on the HUD in the cockpit. The IFTS can passively detect and track air targets. Block 60 is also equipped with the Northrop Grumman Falcon Edge Integrated Electronic Warfare System.

## F-16V 'VIPER' Block 70/72

Lockheed Martin started to work on Block 70/72 to provide F-16 users with the new capabilities that they need in the current combat environment. The "Mid-Life Update" (MLU) program, which will be applied to existing F-16 aircraft, is intended to be the same as the new aircraft. The Northrop Grumman ANAPG-83 SABR (Scalable Agile Beam Radar) radar forms the center of the program. Another important feature of the F-16V configuration is the CPD (Center Pedestal Display). With its high resolution 6 x 8-inch screen, it allows the pilot to take full advantage of the data from the radar and targeting pod. The Auto GCAS (Automatic Ground Collision Avoidance System) system has become standard with the Viper configuration. Thanks to this system, the aircraft performs a self-rescue maneuver without pilot intervention to prevent collisions if the pilot passes out as a result of high Gs or if the airplane gets out of control and loses altitude as a result of disorientation. With the new radar, avionics, secure data link, and electronic warfare systems, the Viper will have reached operation levels of a fifth-generation aircraft.

# F-16 Fighting Falcon's Turkey Adventure

To establish the aviation industry in our country, three significant attempts were made in 1925, 1935, and 1939 and a total of 252 civil and military aircraft were manufactured, and some were even exported to foreign countries. Although factories were established and started production, these initiatives, which aimed to bring new and modern management systems to our country, had to stop their activities due to bottlenecks in production and management due to the lack of necessary support. Therefore, the Turkish Air Force Support Foundation was established on July 16, 1970, to meet the industry's investment and financing needs. To establish, preserve, and regulate the National Aviation Industry in light of previous initiatives, the Turkish Aircraft Industries Corporation "TUSAŞ" (55% owned by the Treasury and 45% by the Turkish Air Force Support Foundation) was established under the auspices of the Ministry of Industry and Technology by Law No. 1784, adopted on June 28, 1973. Turkish Aerospace worked on the co-production project of the evolutionary-close support aircraft needed by the Air Force Command between 1976 and 1977 and was stopped in October 1977 when the agreement phase of the project was reached. Later, a delegation consisting of Air Force Command officials and Turkish Aerospace personnel was established in March 1979 to identify the aircraft that met the qualifications at the directive of the General Staff. In April 1979, the Higher Planning Council decided to establish an aircraft factory in Ankara, and the expropriation of 5 million m2 of land started at the Mürted region. Negotiations were held with international aircraft manufacturers and their governments, and these negotiations continued for about three years. In the 1980s, General Muhsin Batur started the "Build Your Own Plane" project. As a result of the activities carried out in this context, the F-14, F-15, Viggen, Jaguar and Tornado aircraft were eliminated for performance and economic reasons, while the Mirage F1 and 2000 were eliminated due to France's anti-Turkey attitude. As an alternative, three American aircraft were left. These were the F-16C/D, F/A-18, and F-5G. All the manufacturers of these three aircraft also accepted the joint production requirement of Turkey. The F-16C/D and F/A-18A aircraft were selected for the final two in the tender and Turkey sent a Request for Proposal (RFP) to the US Government for the joint production of 160 aircraft in 10 years. In August 1983, General Dynamics F-16C/D aircraft were selected for joint production.

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Turkey's F-16 adventure started on December 9, 1983, with the signing of the Letter of Acceptance (LOA) between the Turkish Air Force and the U.S. Air Force for 160 F-16 aircraft. The total cost of this project, called PEACE ONYX, was US$4 billion. With the agreement, the first eight aircraft would be manufactured at General Dynamics Fort Worth facilities, while the remaining 152 (136 F-16C and 24 F-16D) would be manufactured at TUSAŞ facilities. In July 1984, General Electric's F110-GE-100 engine was chosen to be used on the F-16C/D aircraft. Turkish Aerospace Industries was established in 1984 with General Dynamics, with US$137 million in capital. 49% of this company was owned by TUSAŞ, 2% was owned by the Turkish Aeronautical Association and the Turkish Air Force Support Foundation, and 49% was owned by foreign shareholding.

Turkish Aerospace started its first F-16 production activities on February 2, 1987, including the front, middle, and rear fuselage assembly. The assembly activities of the F-16 aircraft continued with the production of the rear and middle fuselage in 1988 and the wing production in 1989. Aselsan manufactured the LN-39 INS system to be used in the aircraft under the Litton license. The first F-16 aircraft were delivered to the Turkish Air Force with a ceremony held at General Dynamics Fort Worth facilities on July 17, 1987. 4 of the eight planes flew to Turkey in 1987. The other four aircraft were delivered by cargo aircraft. The first F-16C Block 30 (86-0068) manufactured at Turkish Aerospace facilities made its first flight on October 14, 1987, under the control of test pilot Şener KOLTUK. Within the framework of the Peace Onyx program, the first 4 F-16D fighters were delivered on October 20, 1987, with a big ceremony. After completing its tests, the first F-16C aircraft manufactured by Turkish Aerospace was delivered to the Turkish Air Force on November 27, 1987. Until January 1990, 32 F-16C Block 30s and 3 F-16D Block 30s were manufactured. As of the 44th plane, Block 40 configuration planes started to be delivered. Initially, the production process only started as the assembly of parts, but later Turkish Aerospace started to manufacture 70% of the aircraft fuselage.

The Turkish F-16 aircraft Self Protection Electronic Warfare System (SPEWS) contract worth US$325 million was signed between MIKES and the Undersecretariat for Defence Industries (SSM) in September 1989. The AN/ALQ-178(V)3 system produced by the LORAL company was selected. A national threat library was also established with the project. The system


*Turkish Air Force F-16C Block 50M aircraft were equipped with the AN/ALQ-178(V)5+ ECM system under the SPEWS-II project. The distinctive ECM antennas are an integral part of the formation lights*

can warn in the C-J band and jam in the D-J band. The system displays the threats and alerts the pilot with an audible warning. It consists of two main parts, RWR and ECM. With the project, 160 RWR (Radar Warning Receiver) and 122 ECM (Electronic Countermeasures) systems would be installed on the aircraft. Since there wasn't enough room for the ECM system's avionics in F-16D jets, only the passive RWR system was installed. Within the framework of the project, an intense and challenging test program was carried out in the USA for over two years with a team of 30 members of the Turkish Air Force, two F-16 and accompanying pilots, technicians, and engineers. During the tests, various Eastern and Western radar sensors imitated different threats in various scenarios defined by the Turkish Air Force and detailed by MIKES. A total of 40 sorties were conducted. With this study, Turkey became the second country in the world to carry out its own EW test after Israel. Moreover, MIKES completed the engineering work on the compatibility of ALQ-178 and AIM-120 AMRAAM missiles in cooperation with Lockheed, Hughes, and Raytheon. Thus, Turkey verified that the ECM system could operate without jamming the seeker of the AIM-120 missile. The ALQ-178 Electronic Warfare Modification Program was combined with the "Falcon-Up" program to save time and costs.

The Turkish Air Force acquired the LANTIRN (Low-Altitude Navigation Targeting Infrared System for Night) system through the FMS channel under the Peace Moon program. Within the framework of the US$183 million Peace Moon contract, 40 navigation pods and 20 targeting pods would be delivered along with the necessary technical and tactical training, logistic support, and maintenance/repair capabilities. The LANTIRN pods and support equipment arrived in Turkey in June 1993. 6 pilots selected by the Turkish Air Force completed their receive combat readiness training in the USA. The "Bat (Yarasa)" LANTIRN Squadron was established with 2 US instructor pilots and six additional pilot trainees and was activated on 6 January 1994. During this period, all pilots received training, especially in AGM-65G and GBU-10/B firing tactics and techniques. In 1997, 20 more targeting pods were ordered.

The Peace Onyx-II program started on March 26, 1992, with the signing of the Letter of Acceptance (LOA) between the Turkish Air Force and the US Air Force, which included the purchase of 40 F-16C/D Block 50 and the 40 optional aircraft. Within the scope of the program, 96 F110-GE-129 were produced by TEI. The new engines have an increased thrust of 29,000lbs. (13,182kg). In return for Turkey's support after Operation Desert Storm, the Turkish Defense Fund (TDF) was established with the participation of Saudi Arabia, Kuwait, the United Arab Emirates, the US, and Turkey. This Fund was created primarily to finance the Peace Onyx II program. The related deliveries under the Peace Onyx/Öncel-I Project were completed in March 1994. Production of the aircraft started in July 1996 under the Peace Onyx-II program. With this project, Turkish Aerospace increased its aircraft manufacturing rate to 80% with the addition of the front fuselage parts and flaperons. The last plane of the PO-II program was delivered at a ceremony held on November 12, 1999. Thus, 60 F-16C Block 50 and 20 F-16D Block 50s entered the inventory of the Turkish Air Force. With the widespread use of BVR (Beyond Visual Range) missiles such as AIM-120 AMRAAM, the importance of IFF (Identification Friend or Foe) systems has increased. Using an IFF transponder is not enough to determine whether the target detected by radar is friend or foe, and an aircraft must be equipped with an interrogator system. Therefore, the AN/APX-109 IFF system was installed to Block 50 aircraft to allow the F-16s to safely fire AIM-120B missiles after interrogating targets detected with the APG-68(V)5 radar. Another addition is the AGM-88A HARM capability against enemy radars. In September 1998, the 151st

Squadron was activated at the 5th Main Jet Base with its Block 50 aircraft and AGM-88 missiles. Unfortunately, the PO-II planes flew without Electronic Warfare capability for many years. Due to the delayed electronic warfare system selection within the scope of the Öncel-I Project, the aircraft had to return to the factory again to receive the necessary modifications. In addition to the extra time spent, this cost about an additional US$25 million. Despite this experience, the electronic warfare system's selection process could not be completed in time as part of the Öncel-II Project. The US$223 million SPEWS-II contract to provide Electronic Warfare systems for a total of 80 Öncel-II F-16C/D Block 50 aircraft was signed on March 22, 1999. However, for various reasons, this contract was terminated on October 25, 1999, and on December 6, 1999, a new agreement was signed with Aselsan under the same project. The deal was canceled before coming into force due to both the political developments in France against Turkey, which affected Aselsan's partner in the project directly, and the USA's restrictions on the use of foreign electronic warfare systems on its own production platforms. As a result of the negotiations, Aselsan took over 72% of MIKES shares, and 3% of shares were transferred to the SSM (now the SSB). The process, which was turned into an unresolved mess, ended with a new tender on January 15, 2003. With


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the contract signed at the Undersecretariat for Defense Industries, it was decided to integrate the AN/ALQ-178(V)5+ system into F-16C Block 50 aircraft. Aselsan was selected as the main contractor with MIKES as the subcontractor. But the problems remained. The SPEWS-II project was completed in 2016 after the CCIP program.

With the PO-III program, studies began in 2003 for the mid-life upgrade of the F-16s, the leading combat aircraft of the Turkish Air Force. In this context, a program similar to the Common Configuration Implementation Program (CCIP) of the US Air Force was prepared for F-16 aircraft. The project aimed to modernize Block 40 and 50s to meet current needs and to eliminate the differences between the Blocks.

While the CCIP project was continuing, 30 F-16C/D Block 50+ were ordered under the PO-IV program to replace the planes lost due to accidents. With the CCIP program, the Turkish F-16s were upgraded to the level of Block 50+ jets. The first phase of the project covered the procurement of the necessary avionics for the modernization program. These were later integrated into ten prototype aircraft at Turkish Aerospace facilities under two steps, TVI (Trial Verification Installation) and LTF (Lead the Fleet). On July 2, 2007, the TVI phase started with the arrival of one F-16C Block 40, F-16D Block 40, F-16C Block 50, and F-16D Block 50 at Turkish Aerospace facilities. Turkish Aerospace completed the modification of these four planes as part of the TVI phase and then sent them to the USA for testing at Lockheed Martin's Forth Worth facilities. During the tests conducted at Fort Worth, 4 F-16C / D Block 40 and Block 50 aircraft carried out a series of test flights with JSOW, AIM-9X Sidewinder, AIM-120C AMRAAM and AGM-84K SLAM-ER missiles. The CCIP project serial modernization protocol was signed on January 19, 2010. With the project, a total of 165 F-16C/D Block 40 and Block 50 aircraft were modernized. The F-16C/D Block 30 jets also received a partial modernization. The 1st HIBM Command and Turkish Aerospace replaced the RIBs (Turkish Aerospace production) on the bulkheads and wings of the planes to extend the life of the Block 30 type F-16s. The PO-III aircraft had the same mission computer (MMC 7000) and Operational Flight Program (OFP) as the PO-IV aircraft. Source codes of Block 40 aircraft were taken from the USA before CCIP. The Block 40 System Integration Laboratory (SIL) was established at the 1st HIBM, and nationally developed ammunition started to be integrated into the aircraft. Turkey requested the source code of the MMC 7000 mission computer software, but the USA did not accept this

request. Within the scope of Serial Modernization, Turkish Aerospace delivered the first aircraft to the Turkish Air Force on November 2, 2011. 149 of 165 aircraft were modernized at Turkish Aerospace facilities and the other 16 aircraft at 1st HIBM facilities under the main contractor Turkish Aerospace.

Under the project, F-16C/D Block 40 and 50 planes received the common configuration upgrades as follows:

- Advanced Modular Mission Computer
- Advanced AN/APG-68(V)9 radar
- AN/APX-113 AIFF
- LINK-16
- Self Protection Electronic Warfare System (SPEWS-II)
- LANTIRN-ER Navigation Pod
- SNIPER / ASELPOD Targeting Pod
- Joint Helmet Mounted Cueing System (JHMCS)
- Integrated GPS/INS System
- Full-color MFD
- Electronic Data Entry System

50 AGM-154A, 50 AGM-154C, 50 AGM-84K SLAM_ER, 50 CBU-105, 200 GBU-31, 200 GBU-38, 127 AIM-9X, 107 AIM-120C-7, 30 AN/AAQ-33 Sniper Targeting Pod, 30 AN/AAQ-13 LANTIRN ER navigation pod and 20 ASELPODs were also purchased for use on the PO-III and PO-IV aircraft.

The PO-III program was successfully completed on April 10, 2015, with the


*F-16C Block-30TM (Turkish Modernization) aircraft with the DB-110 reconnaissance pod*

delivery of the F-16D Block 40M (aircraft that received CCIP modernization are identified with M) with tail number 89-0044.

At the Defense Industry Executive Committee (SSIK) meeting held in December 2006 for the Peace Onyx-IV program, the Undersecretariat for Defense Industries (SSM) was authorized to procure 30 F-16 Block 50+ (16D and 14C) aircraft from Lockheed Martin via the Foreign Military Sales (FMS) channel. Accordingly, Turkish Aerospace signed a contract with the main contractor, Lockheed Martin, on December 5, 2008. The program ended with the last F-16D Block 50+ (07-1030) delivered on December 11, 2012. This aircraft is the 308th and last aircraft produced by Turkish Aerospace. Unlike the PO-III, the PO-IV aircraft are equipped with the AN/ALQ-211(V)4 Advanced Integrated Defensive Electronic Warfare Suite (AIDEWS). These aircraft can carry a CFT. The F-16D Block 50+ aircraft also feature a Dorsal Spine. In this way, the AN/ALQ-211(V)4 can be carried internally, allowing the aircraft to be used for combat missions. Unlike other F-16C/D planes in the Turkish Air Force inventory, Block 50+ aircraft are painted with a special radar-absorbing (RAM) paint called Have Glass II, which reduces the plane's radar cross-section. Additionally, the liquid oxygen system in previous models was replaced with the On-Board Oxygen Generating System (OBOGS), which is safer and easier to maintain.

The Özgür Project, which started on December 15, 2010, at the request of the Air Force Command, aims to equip 35 F-16 Block 30 aircraft, which were not modernized under the CCIP project, with a national mission computer (OFP) and national avionics. With the nationalization of mission computers, the project aims to ensure the integration of national air-to-air and air-to-ground munitions. The experience will be used in the Hürjet and MMU projects. Aselsan will develop the hardware of the mission computer to be used in modernization, and Turkish Aerospace will develop the OFP software. An F-16C Block 30 (87-0019) was used as the prototype aircraft in the project. The cockpit of the plane was also updated, and a new full-color multifunction display (MFD), middle cockpit display and engine display have been added. Work on the first aircraft continue within the scope of the project.

For the 19 F-16D Block 50, 13 F-16D Block 40, and 8 F-16D Block 30 aircraft that are in the Turkish Air Force inventory and do not have an active Electronic Warfare system, a total of 42 (in two batches) Exelis AN/ALQ-211(V)9 Advanced Integrated Defensive Electronic Warfare Suite (AIDEWS) pods were procured via the Foreign Military Sales (FMS) channel. The pods have an all-digital radar warning receiver, broadband digital radio frequency memory (DRFM), ALQ-213 Countermeasure Set (CMS), in-flight reprogramming, and both

low (B, C, D) and high (J and K) Radio Frequency jamming capabilities.

On 24 December 2012, 4 DB-110 reconnaissance pods and 2 Image Analysis Stations (one fixed and one mobile) were ordered. Although the pods were initially planned to be integrated into F-16C/D Block 50+ planes, the contract was later renewed to integrate them into F-16C/D Block 30 planes. A new Operational Flight Program (OFP) was needed for integration into the F-16C Block 30s. F-16C Block-30TM (Turkish Modernization) planes in which the pods are integrated were modernized in the 1st HIBM before integration and some of their avionics, especially the mission computer, were upgraded. The old generation EFCC Mission Computer used in the aircraft was replaced with the GAC Mission Computer with national OFP, which was removed from the F-16C Block 40 aircraft modernized under the CCIP program, and the LN-39 INS/GPS was replaced by the more advanced LN-93 INS/GPS. This project was carried out by the 1st HIBM's Technology and Weapon System Development Command, using completely national capabilities. The integration of the pods was completed with the test flights of the 401st Test Squadron.

Under the F-16 Block 30 Structural Modernization Program contract signed on 10 August 2015, structural improvement work was started to increase the service life of 35 F-16C/D Block 30 aircraft. With this modernization, the service life of the F-16C/D Block 30 aircraft was planned to be extended to 12,000 hours from 8,000 hours.

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*Turkish Air Force F-16C Block 40M (Falcon-up) during aerial refueling. This particular F-16 (90-0011) is also the former aircraft of the "Solo Türk" Demo Team*

The F-16 is one of the most upgraded aircraft in aviation history. There is a lot of difference between its original purpose and its current use. It reached a completely different level in terms of capability. It evolved from a lightweight day fighter to a deep strike aircraft in a few decades. It is more than enough to look at the production numbers and the number of users to understand how successful the design is. If we look at Turkey, the F-16 changed our aviation industry as much as it changed our military aviation. Thanks to the "Fighting Falcon," we now have an aviation industry that started with assembly and then continued on with production and modernization, and now we can design our own aircraft. "Build Your Own Plane" came true. As the main strike force of our Air Force for 33 years, F-16 fighters will continue to be our main strength in the skies for a long time to come thanks to our indigenous munitions, national modernization projects such as "Özgür" and the continuous development of our defense industry ■


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*F-16 "Özgür" Cockpit*

# Status Report: EHPOD & EDPOD Projects

by İbrahim SÜNNETÇİ

**The Project on the Development of the Electronic Warfare Pod (EHPOD) System for F-16 Aircraft is being executed with indigenous facilities under the coordination of TÜBİTAK. The Critical Design Stage of the Project has been completed and the integration activities are in progress. Capable of using both 'coherent' and 'non-coherent' techniques due to its DRFM technology is optimized as the self-protection pod of the F-16 Aircraft, the EHPOD System is able to provide users with "considerably more" effective radiated power (ERP) from both the AN/ALQ-211(V)9 and EL/L-8225 external EW Self-Defense Pods in the inventory of Turkish Air Forces Command (TurAF/HvKK) and internal EW Self-Defense Systems.**

The Project on the Development of the Electronic Warfare Pod (EHPOD) System for the F-16 Aircraft was launched by the Ministry of National Defense (MoND) within the scope of the demands of the TurAF. The Project is being executed through indigenous facilities under the coordination of TUBITAK in line with the signed contract. The Project was planned to be realized through10 stages each of which lasts 6 months and activities were launched as of December 1, 2014. According to news published in the press in December 2014, the EHPOD's cost per aircraft was projected as nearly US$ 2 million and the cost of the development and prototype production was estimated at the level of TRY 135 million.

Within the scope of the Project, three EHPODs will be manufactured as serial production prototypes. During attack, defense and joint operations of F-16 Aircraft, the EHPOD will enable self-protection against air defense elements. It is designed as an external pod and it will be integrated to the aircraft and operate in coordination with the KTAS/CMDS with receiver (RWR) and jammer (ECM) features. It is being developed as a system capable of functioning unaided in all flight profiles of the F-16 Platform.

The RWR gives warning as it detects threat radars in the environment, generates data on the direction and the identity of the radar while the ECM system launches Electronic Warfare (EW) to the threat detected by the RWR. The EHPOD will conduct its tasks by utilizing the data on the identified threat, EW technique and system parameters in its task data file. The interface between the EHPOD and the pilot will be achieved with the Pilot Imaging and Control Unit developed as part of the Project.

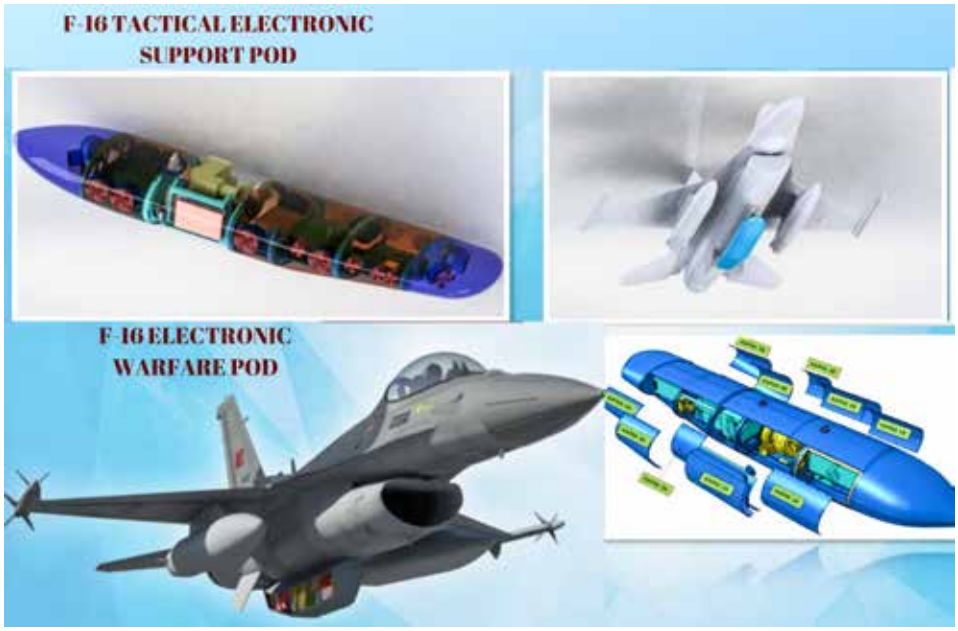
The EHPOD Project is being funded by the TÜBİTAK Support Program for the Research and Development Projects of the Public Institutions. TUBITAK BILGEM ILTAREN is the Project Manager; TUBITAK BILGEM BTE, TUBITAK UZAY and Havelsan EHSIM are the Project Coordinators. Environmental conditions verification and external load certification tests of the EHPOD are being carried out by TUBITAK SAGE. Joint activities are being conducted with the 1st Air Supply and Maintenance Factory Directorate (former 1st Air Supply and Maintenance Center Command) under the TurAF for the identification of the interface with the F-16 aircraft and the integration.

In TUBITAK's recently published 2019 Annual Report, the following information was shared on the latest status of the Project: "The Unit Tests and Critical Design Stage of the Electronic Warfare and Electronic Support Pods have been completed. These are the very first indigenous and national Electronic Warfare Pods.

They are being developed for the F-16 Aircraft platform and integration activities are also being carried out as part of the Project."

We had the opportunity to get in contact with a TUBITAK official at a fair held in 2018 and we were informed that the Critical Design Phase and the initial tests in the laboratory environment had been completed. We were also told that the activities regarding the integration phase had been launched in the second half of 2018. On that very date, the integration activities over the F-16C were planned to be conducted in 2018 and the test flights with the F-16C were intended to be launched in 2019. In light of the information provided in the Annual Report, it may be considered that the first EHPOD flight test to be executed over the F-16, that was previously expected to take place in 2019, could only be conducted after the completion of the integration activities in 2020 or in the beginning of 2021.

The indigenous EHPOD System is being developed as a self-protection (Self-Defense) pod. Self-protection pods are capable of fulfilling operational requirements different than Escort Jamming or Stand-Off Jamming (SOJ) systems, therefore their system requirements are different. Utilization of a pod optimized specifically for one, in the other, is generally not preferred. The indigenous EHPOD is a system optimized as the self-protection pod for the F-16 Aircraft. The F-16 Aircraft is an aircraft with a wide range of flight profiles




and maneuver capability, therefore the design and development of a pod that can be operational in all flight profiles requires the optimization of numerous system functions in an interrelated manner. Another parameter that affects the success in the development of such pods is analyzing all threat spectrums well and carrying out the design and production of the system functions in a way to be effective against all potential threats. All such issues require a very strict development life-cycle where the EW system criteria are identified by the relevant Force in line with specific operational requirements, hardware and software designs that are optimized in accordance with such requirements. Threats are analyzed in a comprehensive and detailed manner and where verification and validation are realized through the execution of large-scale field tests. Moreover, the development of indigenous algorithms is absolutely essential for the performance and security of the system and this entails a deep scientific background and field experience.

The Indigenous EHPOD is a new generation electronic jamming system that is capable of smart jamming through its internal DRFM (Digital RF Memory). This system is designed in a way to feature listening, sense of direction, jamming, deception and noise capabilities. With its broad band, narrow and wide band RWR sub-system, high precision sense of direction, high effective radiated power (ERP), DRFM based broad beam jamming and deception capability optimized for the criteria it is designed upon, multiple simultaneous engagement capability, high-performance heating/cooling system (Environmental Conditioning System [ECS]) enabling the system to operate in all flight profiles, advanced jamming techniques effective against all threat spectrums in line with the operational requirements and reprogramming feature through the Task Data File developed with indigenous design, it is a system ranked among the top category of the EW Pods that exist in the inventories of developed countries.

According to the information shared in the 2016 Havelsan EHSIM Annual Report published in February 2017, the EW Suite Manager concept was developed for EHPOD's integration into the F-16C Aircraft and upon its preliminary design, the system was revealed as a result of the activities performed with the 1st Air Supply Factory Directorate. According to the report, as of December 2016 the hardware and software development activities were being carried out. The report also stated that the Radar EW Simulator (RASSIM) developed as part of the Project would enable the application of threats, that the EHPOD might encounter in the battlefield, into the antenna inputs at laboratory. The threat signals with phase simulation to be generated in 4 different channels by RASSIM in line with


*Both EHPOD and EDPOD were displayed at TÜBİTAK BİLGEM booth at IDEF' 19*

the generated scenarios will be applied to the EHPOD to test operational performance of the system.

Within the scope of the Project which was planned to be completed in 2019 (though this schedule could not be achieved) TUBITAK UZAY is responsible for the structural design of the pod, cooling system design, aerodynamic design, power distribution unit design and design of the case. Additionally, the structural design of the EHPOD to be utilized in the F-16C combat aircraft that will fly at supersonic speeds, was made in line with military standards by TUBITAK UZAY. The outer shell geometry of the 4-meter long EHPOD was designed as similar as possible to the external centerline fuel tank of 300 gallons (1.150 liters) of the F-16 Aircraft. Aluminum alloys and composite materials (for a light weight and resilient product) are utilized in the production of the pods. The turbo compressor, exchanger, pump, accumulator, pipe system and unions/ fittings are part of the 100% indigenously designed cooling system which guarantees the system's performance under all F-16 flight conditions.

Liquid cooling technology is used in the active heat control system of the EHPOD. The EHPOD with liquid and air cooling and natural heating during the flight receives the air as RAM Air through the air inlet near the front of the hull and spreads it within the pod through the turbo compressor. A RAM Air Turbine (RAT) was not required in the EHPODs as the F-16C Aircraft is able to supply the power required for the system. As a result of the adequate energy efficiency and the existing power supply in the aircraft, there is no need for a RAT type cooling technology.

According to the information we obtained, instead of using Active Electronically Scanned Phased Arrayed (AESA) antenna technology, a broad beamed multiple 'horn' antenna group was utilized in the EHPOD System which is to be integrated and certified for the F-16C type aircraft. The main objective behind the design of this structure is ultimately achieving efficiency in jamming. This form of antenna acquires broad beam capability that could best tolerate direction faults likely to occur in all the maneuvers of the F-16C Aircraft. In conclusion, since the EW Pod is a self-protection EW Pod instead of an Escort Jamming pod, and as the primary purpose consists of the self-defense of the carrier F-16 Aircraft, the multiple 'horn' antenna group design is preferred as the most optimum and cost-effective solution.

In order to fulfill the high ERP requirement, RAT is used in the AN/ALQ-99 series Tactical Jamming System (TJS) and the EL/L-8251 Escort Jamming Pod. Aerodynamic problems occur at supersonic speeds when the RAT is used in the front part of the pod (as seen in the EA-18G Growler and the AN/ALQ-99 TJS), in addition, no antennas can be placed at the fore part of the pod. Instead of a RAT, a High Impact RAM Air Turbine (HIRAT) is being used in the New Generation Jamming (NGJ) Pod that is being developed for the EA-18G Growler Aircraft. According to open sources, while the RAT within the AN/ALQ-99 Pod has a power capacity of 27kW, the HIRAT generator in the NGJ Pod with AESA antenna technology and Gallium Nitrate (GaN) based semiconductor chips (in this way it could be placed in the centerline instead of the nose part) is capable of generating power over 140kW. It is also stated that it will have 360-degree coverage capability as it will feature an antenna in the fore part in contrast to the ALQ-99. There are two CW transmitters in every ALQ-99 Pod and the ERP value of each of these transmitters could reach over 100kW depending on the frequency band. The ERP value for the NGJ Pod is targeted as 1MW. The EA-18G Growler will be able to perform while at supersonic speeds with the help of the NGJ Pod, however, according to open sources, the jamming task can be performed usually at Mach 0.95 that is the speed where the system reaches its highest efficiency.

According to the information we obtained, the EHPOD System is capable of providing its users 'considerably more' effective radiated power than both the external EW Self-Defense Pods such as the AN/ALQ-211(V)9 and the EL/I-8225 in the inventory of the TurAF and internal EW Self-Defense Systems.

The EHPOD with a high-capacity DRFM capability is able to apply modern coherent and non-coherent jamming techniques to more than one threat radar. On account of such capacities, the EHPOD is also capable of eliminating the effectiveness of threat radars both in search and track modes.

Modern EW Pods utilize both 'coherent' and 'non-coherent' techniques against threat radars. The technique of phase coherent jamming is claimed to be the top-level jamming technique in technological terms.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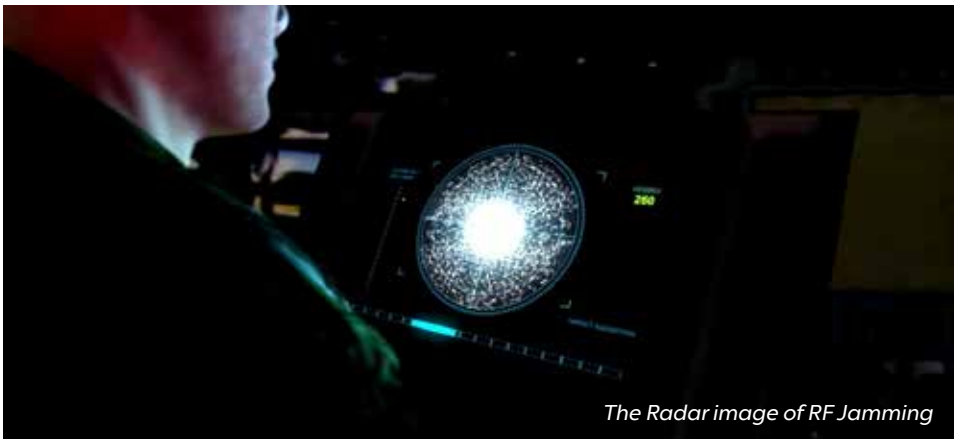
Here, the pulse of the threat radar is acquired through utilizing a DRFM and it is recorded and the ET/deception technique is applied and transmitted back to the radar. In this way the radar is convinced that its own pulse returned if it is technologically smart radar. However, if you apply ET over a smart radar without a DRFM, then you say to the radar that you're not jammming it with the artificial pulse transmitted, and in this case when this radar receives the transmitted pulse, it is able to detect that it doesn't belong to it and thus leaves it aside (the 'jamming stop' capability). Therefore, it is not affected by electronic jamming. This capability is called ECCM.

The EW Pod is a strategic product with critical value. Therefore, it has to be developed through indigenous facilities. Because of a few lines of code discreetly installed in the pod by a foreign manufacturer, an imported EHPOD may not be utilized effectively if Turkey goes to a war in the future with the same country that the pod is imported from or with a country that is an ally of this country. Since EW Pod or radars have a sensor (receiver) and as these receivers are designed in a way to receive a certain series of pulses (certain frequency bands), they could easily switch to failure mode due to special software/code previously embedded in the EW Pod or the radar by the manufacturer company. For instance, the system could be triggered to signal a 'temperature warning' through transmitting a series of pulses. Even if the temperature is 25 degrees, because of the pulse transmitted, it can be perceived as 90 degrees and the system may shut itself down due to the Built-In Test function. Therefore, the indigenous EW Pod and air defense radar systems as well as the software and algorithms used in these systems are essential. For instance, due to the EW techniques used during war, Ukraine is not capable of utilizing many of its systems based on Russian technology against the Russian Army or on the separatist powers supported by Russia.



*The Radar image of RF Jamming*

Internal and Pod type EW Self-Defense Systems are designed in a way to receive a radar pattern; you can instruct what to do when the pattern is received. The system receives the wave of the threat radar, selects the deception/jamming technique and launches the jamming/deception process. By analyzing the pulse transmitted through the radar, the system detects that it is a SA-8 System then identifies it and the EW is launched with the technique compliant with the SA-8 in the Task Data File over it. If no technique is available in the Task Data File, then the System applies the noise technique.

On the other hand, TUBITAK BILGEM has been developing a Tactical Electronic Support Pod (EDPOD) also for the F-16 Aircraft in addition to the EHPOD. The EDPOD features an outer Shell similar to the external fuel tank of 300 gallons at the centerline of F-16 Aircrafts as well. Unveiled at TUBITAK's booth at IDEF '19, the EDPOD System will contribute to the Electronic Order of Battle (EOB) by detecting and identifying threat radars and utilizing their geographical position data. Actually, Electronic Warfare starts way before facing the enemy's aircraft and/or their missiles. Initially, the information and data on the surface, underwater, air and land platforms and the spectral bands/ frequencies of the radars and sensors over them and on the weapon systems they carry (potential threats) should be collected via the EDT/ ELINT Systems and this data should be installed to the EW Data Bank during peace time and a reliable and high-resolution 'Electronic Order of Battle' that will contain all potential threats [surface, underwater, air and land-based] in the area of operation should be prepared. Because the reaction is launched upon the formation of the EOB and on account of the EOB previously prepared, the friendly components' control over the zone will be facilitated. The tactical EDPOD System is capable of detecting threat radars via the Wide-Band and Narrow-Band Receivers over it. After identification, the arrival direction, frequency, pulse width, pulse amplitude, pulse repetition frequency, antenna scanning and inter-pulse modulation parameters are generated. Through the utilization of the arrival direction of the radars, their geographical positions are calculated. The EHPOD System records the contact parameters, location info, Pulse Descriptor Word (PDW) values and raw Intermediate Frequency data of the threat radars for post-operation analysis. It transmits the threat data it acquires to the other EHPODs in the operation field and to the Ground Support System via the Link-16 datalink network. The EDPOD System enables the analysis of the recordings it makes through the software on the Ground Support System. As a result of these analyses, the EHPOD and EDPOD Systems will contribute to the update of the National Joint EW Data Bank ■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# World Leader in the Field of Shock & Vibration with Over 60 Years of Industry Experience: Taylor Devices, Inc.

Taylor Devices was founded in 1955 by Paul H. TAYLOR, as the USA's leading independent manufacturer of energy management devices. The company has a long and rich history in the design and production of shock and vibration isolation products, Including Dampers, Shock Absorbers, Vibration Isolators, Gun Mounts, Shock Transmission Devices, Fluid Springs, Air Springs, Machined Springs, Shock Isolation Systems and Satellite Deployment Systems, are fully certified by the U.S. Government, as well as NASA and various federal and corporate agencies. Their products have been utilized in aircraft, missiles, satellites, spacecraft, ships, submarines, radars, tracked vehicles, and gunnery systems.

Shock absorbers are something that we usually do not consider as an important part of everyday life, but they truly are essential with many different applications and are used on a wide range of commercial and military vehicles. They are also used in more than just vehicles, they are also used in bridges, highways and buildings to absorb the impact from earthquakes and high winds. Different applications require different types of shocks absorbers and different materials. A rubber shock absorber cannot be used exclusively on a vehicle while pneumatic damper cannot be used exclusively on a highway. All the situations require a specific shape and type of shocks to be used for the required tasks.

Headquartered in North Tonawanda, New York, USA, Taylor Devices is spread out over two campuses (Tonawanda Facilities and Buffalo Bolt Way Facilities) encompassing 115,000 sq-ft that include offices, machine shop, assembly department, paint shop, and packaging. While Taylor Devices maintains a wide array of standard products, all these products can be modified to customer specifications. Customized items include single or double acting dampers, non-linear dampers, single and double acting liquid springs, liquid die springs, tension shock absorbers, tension-compression shock absorbers, crane buffers, vibration dampers, machined springs, elastomer springs, gas springs, and custom actuators.

taylor devices inc.

## Custom Vibration Isolation Systems Designed for Customer Needs

A shock and vibration isolation system provides protection against continuous or transient shock and vibration events. Mitigation often includes the integration of special hardware including shock absorbers, dampers, vibration isolators, shock isolators, shock transmission units, etc. A shock absorber or damper is a mechanical or hydraulic device designed to absorb and damp shock impulses and to remove harmful energy from a dynamic system. It does this by converting the kinetic energy of the shock into another form of energy (typically heat), which is then dissipated. Most shock absorbers are a form of dashpot (a damper which resists motion via viscous friction). Shock absorbers absorb a maximum amount of kinetic energy and bring a moving mass to a stop with minimal force, whereas dampers continuously remove energy from a moving system to control its response.

Most shock and vibration isolation systems consist of a combination of some type of suspension elements (i.e. springs), and an optimized level of damping. Isolation systems are designed to operate along any desired plane or axis of motion, up to 6 degrees of freedom, thereby protecting the isolated payload in up to 3 translational axes and in 3 rotational axes of motion. Simple isolators with linear output characteristics will provide some level of protection across a given input frequency range. However, Taylor Devices provides specialized isolation systems that can provide higher levels of protection, thereby effectively reducing the energy input to the isolated equipment over a wider frequency bandwidth. The amount of damping that exists in the isolation system provides a trade-off between response at the resonant frequency of the system and the response at all other frequencies. A low damping level will generally provide a relatively low response over a wide bandwidth but a relatively high response at resonance. Conversely, a high

*Zero-Maintenance Landing Gear Shock Absorbers*

*Recoil/Counter-recoil Absorbers & Controllers*

*Shock Absorbers for Spaceflight and Ground Support Equipment*

*Taylor Devices Load Isolation System, International Space Station*

damping level will generally provide a low response at resonance but will sacrifice performance over the remaining frequency range. Other isolator non-linearities such as friction can further sacrifice system performance.

## Shock and Vibration Isolation Systems for Military & Aerospace Applications

In the field of military land vehicles shock absorbers can be offered for both tracked and wheeled vehicles for almost all axle weights and wheel travel.

Whether handling sudden blasts and shocks, or constant vibrations from energy sources, isolation systems are vital in the military and aerospace fields. When a shock and vibration environment is deemed to be intolerable for a certain system or piece of equipment, the issue must be addressed through discrete changes that will make the environment acceptable. When this is not possible or practical, shock and vibration must be controlled by isolating the equipment, thereby providing protection to the equipment. Similarly, if the equipment itself is producing the shock and vibration, it may become desirable to mitigate this energy from the surrounding environment. Taylor Devices is capable of engineering custom military and aerospace vibration isolators that provide viable solutions to customers/end users' problems.

## Custom Landing Gears for the Aircraft & Unmanned Aerial Vehicles (UAVs)

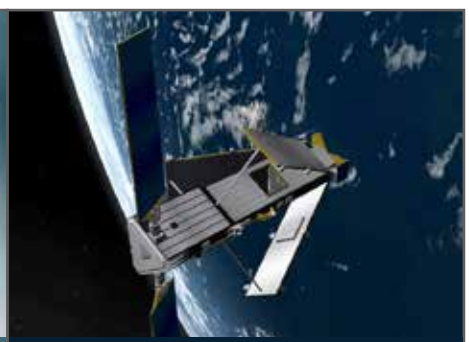
Taylor Devices is in its seventh decade as a key supplier of custom-engineered arresting and landing gears to aircraft. They also provide components for UAV manufacturers that require a maintenance free system that can operate in the harshest of environments, with an established track record of success. Their products meet strict environmental and precision requirements as demanded by the industry.

Taylor Devices' landing gear systems use a non-pressurized design that is inherently safer and capable of operating at the most extreme of temperatures. Its lightweight and compact design allows for a greater payload and increased aircraft range at a reduced cost, with increased durability and performance when compared to conventional landing gear systems. Design solutions are custom tailored to customer requirements and are limited only by the imagination.

## Dampers and Shock Absorbers for Space Applications

Taylor Devices has a long history of working with NASA (National Aeronautics and Space Administration) beginning in the 1960s on the Apollo Program, where engineers developed shock absorbers for ground equipment on the launch platform. From there, the company has been successful in developing many other types of actuators and shock absorbers for spaceflight, including the use of metal bellows dampers, actuators and shock absorbers for use on spacecraft, shock isolation systems for the Space Shuttle launch pad, vibration isolation systems on several launch platforms and in spaceflight, and more. Taylor Devices is committed to designing and building shock absorbers that can be used for future moon landings, spaceflight applications, and other ground support equipment.

*6 Degree of Freedom Isolation Systems*



*Actuators and Dampers for Spaceflight*

# P-180U and MARS-L Radar Purchase from Ukraine and TuRAF PYAS Project

by İbrahim SÜNNETÇİ

According to Ukrainian press, Ukrspetsexport (the only institution authorized by the Ukrainian Government to fulfill the export potential of Ukraine's military-industrial complex), a subsidiary of the Ukrainian state-owned defense company UkroBoronProm (UOP), delivered two P-180U and two MARS-L radars to SSTEK Defense Industry Technologies in late December 2019, under a contract worth US$11,144 million. According to the reports, the total cost of the L-Band MARS-L radar (on the Ural and KrAZ chassis) produced by NPE Aerotechnics-MLT Company is US$ 7,544 million, and the total value of the VRF-Band P-180U (P-18MA) radar (on the KrAZ chassis) is US$3,6 Million.

The mobile L-Band MARS-L is a ground-based combined PSR/SSR (Primary and Secondary Surveillance Radar) system. The combined use of primary and secondary channels considerably increases the detection range and accuracy of finding the coordinates of aerial objects. Additionally, the availability of additional aircraft information such as current altitude, remaining fuel, condition of the onboard systems, etc., together with primary radar information, significantly increases flight safety. It also reduces the likelihood of accidental targeting of civilian aircraft by air defense systems. The MBTF (mean time between failures) performance of the MARS-L, which is a mobile low altitude surveillance radar capable of providing coverage up to 110km on the PSR channel and 150km on the SSR channel, is given as 5,000 hours.

The ground-based VHF (metric band) P-180U (P-18MA) is a long-range surveillance radar which provides the radar information and flight routes of aerial objects. The solid-state P-180U is the modernized and improved version of the VHF-Band 2D (two-dimensional, provides only azimuth and range data) P-18 early warning radar developed during the Soviet Union. The system has coverage of 360km km in range and up to 35km in elevation, and thanks to its long wavelength, the P-180U radar can detect RAM coated aerial platforms with a very high percentage. The system consists of a 360-degree rotating radar antenna and a control center based on KrAz tactical vehicle chassis. It is claimed that the P-18MA/P-180U radar system, which is also used by the Ukrainian Armed Forces, could detect the F-117A Nighthawk Stealth Fighter from 61km.

There are different speculations regarding the procurement of the MARS-L and P-180U radars, which are considered to be capable of detecting stealth aircraft as they operate on the L and VHF bands, by SSTEK Defense Industry Technologies, which was established in 2016 as a 100% subsidiary of the Presidency of Defense Industries to operate in the fields of defense, aviation, space, and homeland security. Considering the number of the systems supplied, the radars may have been procured for testing/evaluation purposes in indigenous aircraft and missile projects or may

*L-Band MARS-L Radar*

have been purchased for reverse engineering or use in EHTES (P-18 radars of the Egyptian Armed Forces were upgraded to the P-180U level by the Ukrainian company).

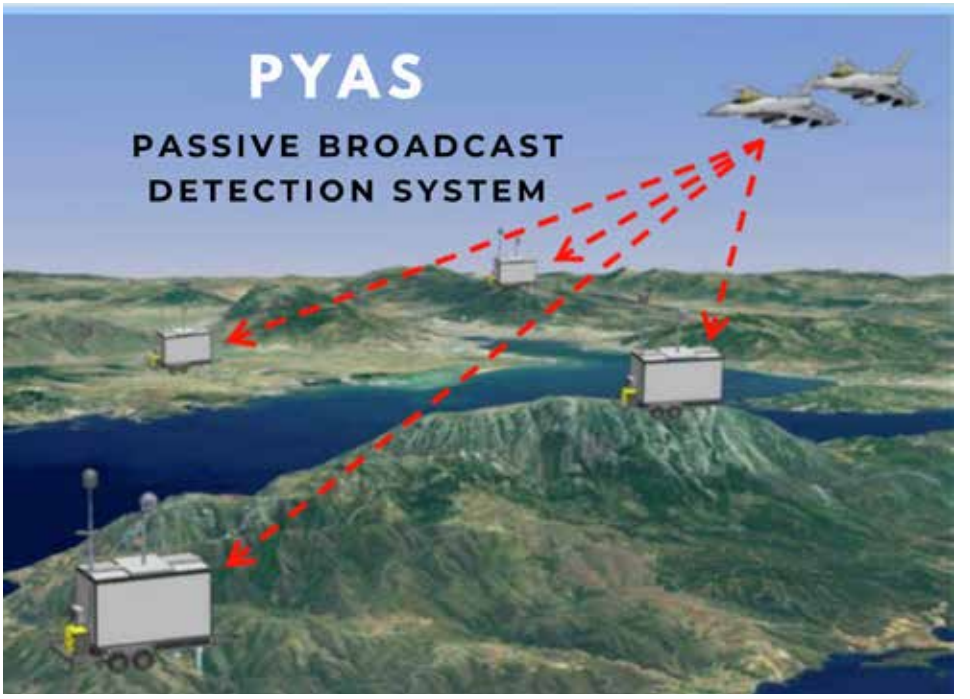
Although the history of diplomatic relations between Turkey and Ukraine dates back 28 years, the military-technical cooperation agreement between Ukraine and Turkey, which is one of the first countries to recognize Ukraine's independence, was renewed in 2014. As part of this process, joint production decisions were made in various areas such as armored vehicles, aircraft engines, missile systems, joint radar production, navigation systems, as well as communication and space projects. Turkish and Ukrainian defense industry representatives gathered in Ankara in 2015, and a strategic cooperation agreement was signed between the two countries in the field of the defense industry in 2016. In July 2018, Turkey and Ukraine conducted the first-ever Turkey-Ukraine Defense Industry Cooperation meeting to accelerate their defense cooperation. The 7th Turkey-Ukraine Defense Industry Cooperation meeting was held at the Ministry of Defense of Ukraine in Kyiv on January 21-24, 2020.

The first activity between Turkey and Ukraine in the field of radar systems was the Memorandum of Understanding (MoU) signed on April 8, 2016, between Havelsan and Ukroboronprom, Ukraine's state defense industry enterprise, for the joint production of the Passive Sensor System (PASİS). During the Arms and Security 2016 Fair held in Kyiv on October 11, 2016, a cooperation agreement was signed between Havelsan and Ukrinmash, a state-owned company under Ukroboronprom, for the production of passive radar systems to increase the long-range detection capabilities of Turkey and Ukraine to a range of 600 km. According to Interfax News Agency, the development of the new passive radar system will be financed by Turkey, and the emerging product will be different from the world-renowned Kolchuga passive radar (ESM System can detect up to 800km).

*P-180-U VHF Radar*

Israel bought a new generation Kolchuga-M Passive Radar System from Ukraine in March 2018 via the company Airstom, and the system was delivered in the same year. It is considered that the Kolchuga-M Passive Radar System can be used in electronic warfare tests, training, and exercises to be carried out by the Israeli Air Force.

## Turkish Air Force PYAS Project




Turkey is no stranger to passive radars; in fact, multiple projects were carried out in this field by domestic companies and institutions. Furthermore, an indigenous passive radar system was developed for the Turkish Air Force under the Passive Broadcast Detection System (PYAS) Project, which was accomplished in cooperation with TÜBİTAK BİLGEM Information Technologies Institute (BTE) Radar Systems Laboratory, Istanbul Medipol University, and Gebze University.

In the TÜBİTAK 2019 Annual Report published recently, the following information was shared regarding the latest situation in the project: "Factory Acceptance Tests (FAT) of the Passive Broadcast Detection System (PYAS) developed for the Turkish Air Force, which performs long-range target positioning and tracking via signals broadcast from air targets, have been successfully carried out." Considering this information, we can say that the PYAS FAT process was completed in 2019, and the Site Acceptance Test (SAT) process have started. Since no information regarding the delivery of PYAS to the Turkish Air Force was shared in the Annual Report, the system may be delivered within the first half of 2020 following the SAT process.

However, at the Military Radar and Border Security Summit held in Ankara on October 2-3 2018, important information about the Passive Broadcast Detection System (PYAS) developed by TÜBİTAK BİLGEM for the Turkish Air Force was shared with the participants (the first field trials were completed in 2018 at the TÜBİTAK Gebze campus). Also, it was stated that the project, which started on December 15, 2015, was planned to be completed on December 17, 2018.

The Passive Broadcast Detection System (PYAS) was developed as part of the Passive Broadcast Detection System Development Project under the TÜBİTAK Public Sector Research and Development Projects Support Program (SAVTAG 1007) to meet the needs of the Turkish Air Force Command. The project proposal was published on March 13, 2015 and was closed on May 29, 2015. PYAS is a passive broadcast detection system that can detect and track signals broadcast from air targets. The system captures broadcasts/signals (both lower and upper frequencies) of various electromagnetic energy sources on the air targets through the receivers located in different locations and finds their position in three-dimensional space. The signals in the Lower Frequency Band (960-1.216MHz) are broadcast by Mode 1, 2, 3AC, Mod-S, TDL (Link 16), and TACAN, while the Radar and RF Jammers emit signals in the upper-Frequency band (8,000-12,000MHz).

Capable of Broadband frequency scanning, PYAS also has phase-interferometry, highly accurate time synchronization, signal detection, feature extraction, signal binding, and SSR Mode-S decoding capabilities.

The PYAS system can detect the arrival time (Time Difference of Arrival/TDOA) between the lower or upper-band signals emitted by air targets and find the air targets' position in 3D space by measuring the relative delays with 4 passive receivers. Unlike other Passive Emitter Tracking (PET) systems in the market, PYAS can also find target aircraft positions using the Angle of Arrival/AOA method. It is enough for a single sensor to detect the signal, but for 3D positioning, the signal must be detected with at least 2 sensors.

The main disadvantage of passive radar systems, which are difficult to detect and deceive, is that they are signal-dependent, so if the threat does not emit a signal, the system cannot detect the target. The higher the bandwidth of the broadcast signal, i.e., the stronger, the better/longer the system's resolution and detection range. Since there are numerous disturbing effects and signals (background clutter) in the environment, target positioning and screen display in passive radars are not as clean as in standard radars, so the possibility of false alarms is much higher. To prevent this, an advanced tracking and merging algorithm was used in PYAS.

Since passive systems are very dependent on geography, the sensors must be optimally positioned in the field and perfectly synchronized with each

other to maximize system performance. A special tool/software was developed to ensure that PYAS sensors can be positioned optimally in the field. Thanks to this software, which was stated to be delivered to the Turkish Air Force with the PYAS system, the operators will be able to see the areas covered by the sensors and detect blind spots on the 3D map. The special algorithm/software can calculate the most suitable geographical positions for the 3D placement of PYAS sensors and provides the optimum placement on the map.

One of the 4 sensors developed for the Turkish Air Force under the PYAS Project act as the command center, although the exterior of each looks the same, the sensor contains additional equipment. The PYAS sensor is a 5m long shelter placed on a trailer with an 8m collapsible mast and electronic cabinet. There is a radome located on top of the mast, which contains the antennas and RF signal conditioners operating in different bands (the term radome is a portmanteau of the words radar and dome). PYAS sensors are operated by two personnel. The systems communicate with each other via a radio link or, if available, with a network (there are radio link antennas on the shelter). The first field trials of PYAS were carried out in 2018 at the TÜBİTAK Gebze campus. The PYAS sensor, which acted as the command center during the field trials, was deployed to the Gebze campus (next to the MGR radar), while the other three (one was deployed to the military airport in Yalova, the other two were deployed to two different hills at different locations) were positioned 15-20 km away from the Command unit. Although the PYAS sensor was not fully completed and did not reach its final performance, the system managed to detect signals up to 90km in the first field tests conducted in a small location (distance between sensors was 5km).

In the TDOA target detection method, as the distance between the receivers/sensors increases, the system performance increases as well, and the system provides the best results when the target aircraft passes through the exact center of the sensors. Therefore, when the distance between the receivers is increased from 5km to 20km, it is considered that the system can detect signals from distances farther than 90 km. The power of the transmitters onboard the target aircraft is also another major factor that affects the target detection range. The detection range of the passive radar increases proportionally to the broadcasting power of the target aircraft. Since the radars can determine their output power, depending on the situation, they can emit low-frequency signals to lower their visibility or high-frequency signals to reach their maximum range. When a radar sends signals at the highest power, its broadcast may be detected at a distance of 300 or 500km, but if the power is low (for example, an LPI radar), it may not be heard even from a range of 50km.

To meet the needs of the Turkish Air Force, the Passive Combined Detection System Development Project was initiated as an R&D project originating from TÜBİTAK SAVTAG and Havelsan EHSİM won the tender. The contract signed between TÜBİTAK, the Ministry of National Defense (MSB/MoND), and Havelsan EHSİM came into force on August 15, 2013, and the studies on the project were then started. The project aimed to develop a Passive Combined Detection System (PBAS) that utilizes Analog FM Radio, Digital Radio (terrestrial), and Digital TV broadcasts. Although a 36-month calendar was planned for the project, unfortunately, this could not be achieved. In the 2016 Annual Report of the company, published on February 28, 2017, it was stated that the work on the PBAS Project was ongoing, and the project was aimed to be completed in 2017. According to the 2016 Annual Report, the system hardware and software development studies continued in 2016 in parallel with the data collection, recording, testing, and algorithm improvement activities in the field. As part of the project, firstly, a Passive Radar Signal Collection and Recording System (STKS) were produced, and then the system algorithms were developed by processing the data collected with this system. In this framework, STKS was integrated onto a commercial vehicle, FM and DAB band antennas were produced, antenna beamforming units and receivers were developed, and field studies were carried out with the SKTS vehicle to collect signals and data. Target analysis and tracking algorithms were developed by analyzing the collected and recorded signals in a laboratory environment. Moreover, mechanical modifications of 4 STKS vehicles scheduled to be delivered to the Air Force Command at the end of April 2017 were completed. One of the vehicles was built to operate on the FM band, and field tests were conducted in 2016 with this vehicle. Following the tests, the user (Turkish Air Force) and the customer (Ministry of National Defense) stated that the STKS met the requirements set by the authorities. To create a reliable test environment, an FM broadcast station was established and was put into operation for tests.

We believe that the Passive Radar Signal Acquisition & Recording System/Passive Compound Detection System (consists of 4 vehicles) produced by Havelsan EHSİM will operate integrated or interactively with the PYAS system developed by TÜBiTAK BİLGEM (consists of 4 shelters). When the PBAS/STKS and PYAS Systems are supported with the Electro-Optical System (EOS, actually an Infrared Search and Track [IRST] System) vehicle based on the LandRover Defender developed for HİSAR-O system, it will provide a significant capability gain to detect stealth aircraft with a low Radar Cross-Section (RCS). This capability will be further enhanced by the commissioning of an indigenous Over-the-Horizon (OTH) radar system that will operate in the VHF/UHF band. In this respect, the Memorandum of Understanding (MoU) signed between Havelsan and Ukroboronprom for the joint production of the Passive Sensor System (PASİS) is of utmost importance


# FREMM Class Frigates of the Italian Navy

*by Cem Devrim YAYLALI*

In the early 2000s, the French and Italian Navies had a common problem. Various ships of both naval forces were rapidly aging, reaching the end of their useful service lives, and unable to respond to current threats.

The French navy wanted to replace their Tourville, Georges Leygues, and D'Estienne D'Orves class ships, while the Italian navy wanted to replace their Lupo and Maestrale class ships. The mentioned ships were commissioned in the late 1970s and mid-1980s, and they needed to be replaced.

The FREMM (Fregate Europeen Multi-Missione) project initially started as a national project in France and became a multinational with Italy's participation in 2002.

The prime contractors of the FREMM program were the French Aramis joint venture between DCNS (now Naval Group) and Thales, working in collaboration with the Italian Orizzonte Sistemi Navali (OSN) consortium of Fincantieri and Finmeccanica. The overall supervision of the procurement was allocated to the European intergovernmental organization OCCAR (Organization for Joint Armament Cooperation). Influenced by the success of the preceding Horizon project, both countries decided to join forces in further collaboration.

However, both navies had different expectations from this project. The Italian operational requirements have resulted in notable differences in visual appearance and capability compared to the French FREMM variants. Italy's desire to provide its ships with area air defense capability resulted in the selection of the EMPAR multifunctional radar, which is also used onboard the Horizon class vessels. Additionally, the Italian FREMMs incorporate Sylver A50 Vertical Launching System (VLS) modules, which can support Aster 30 medium-range surface-to-air missiles. Another significant difference between the two countries' ships is their length. French ships are 142.2 meters long, while Italian ships are 143.9 meters. The difference arises from the lengthening of the vessel to overcome some balance problems experienced in the first Italian ship. Since the added part incorporates additional fuel tanks, the maximum cruising range of the Italian vessels is slightly longer than the French ones.

Six of the ten FREMM class vessels built for the Italian Navy are general-purpose frigates mainly designed for surface warfare (ASuW) scenarios, while four of the ships are in anti-submarine warfare (ASW) configuration.

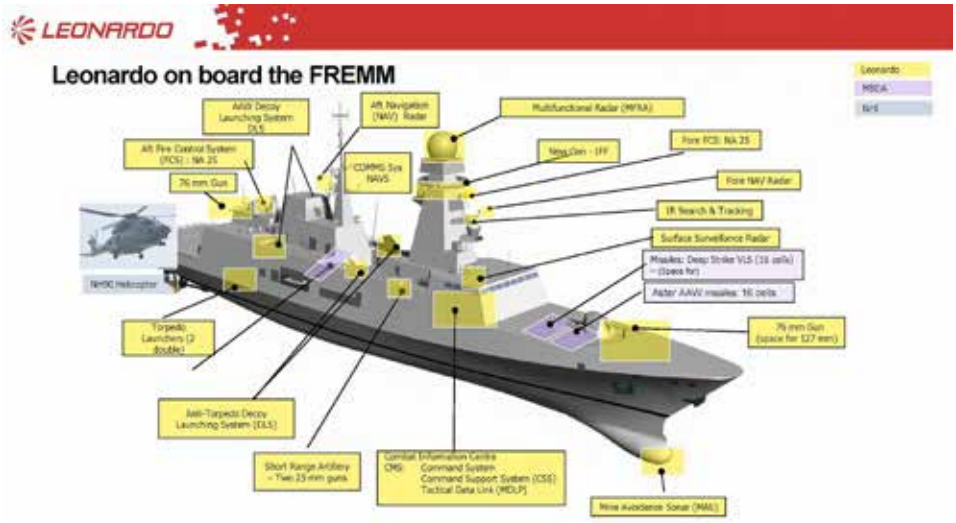
The contract for the first two ships, one general-purpose and one anti-submarine warfare configuration, was signed in 2005. The first general-purpose frigate ITS Carlo Bergamini (F-590) was launched in 2011, followed by the anti-submarine warfare ship ITS Virginio Fasan (F-591) in 2012.

In 2008, Italy ordered four additional ships, one general-purpose and three anti-submarine warfare configurations. The last batch of four ships,

all in general-purpose configuration, were ordered in 2013. The last ship of the class, ITS Emilio Bianchi (F-589), was planned to be commissioned in 2021 before the Covid-19 outbreak.

With a displacement of around 6,700 tons, the FREMM class frigates have an overall length of 144m, a beam of 19.7m, and a draught of 5.1m. The Italian FREMM frigates are powered by a CODLAG (Combined diesel-electric and gas) propulsion system. A single GE/Avio LM 2500+G4 gas turbine, which is rated at 32MW, can sustain a top speed of 27 knots. The ship's primary source of electrical energy is supplied by four sets of 2.1MW diesel generators manufactured by Isotta Fraschini. The generators permit electric propulsion up to speeds of around 12 knots. The diesel-electric propulsion is especially preferred for anti-submarine warfare as it generates less noise than gas turbine propulsion. The ships have a range of 6,000 nautical miles and could carry enough food for about 40 days. The vessel can accommodate 165 crew members. This number may ultimately increase to 200 by installing more cabin units in the space currently reserved for Sylver A70 VLS cells, providing additional accommodation space.

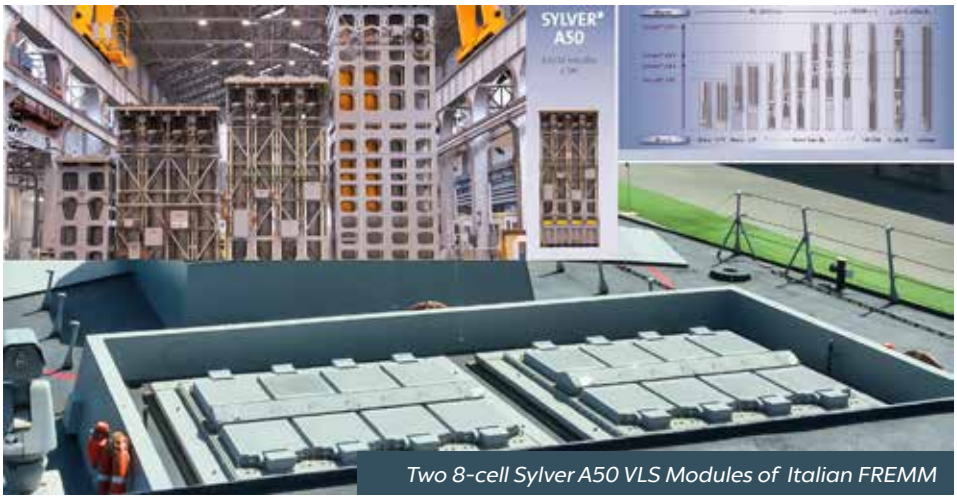
The appearance of the Italian FREMMs is heavily influenced by previous La Fayette class ships commissioned by the French Navy in the 1990s. The vessels' design reflects the attention to stealth that is apparent in all modern




frontline warships. The VLS modules are placed in front of the superstructure just behind the ship's main gun. The small mast on the bridge houses the fire control and surface surveillance radar, and just behind it, the mainmast of the vessel rises, featuring two small exhausts on its either side. Resembling a Padoga, the most eye-catching systems on the mainmast are the Kronos radar inside the spherical radome at the top, and the ESM sensors immediately below the radome with a collar of IFF antennas positioned slightly lower down.

The 25mm autocannons are located on the same deck with the bridge on either side of the mainmast. The launchers of Teseo or MILAS missiles are placed between the mast and the main exhaust funnel. Against air and underwater threats, two OTO Melara SCLAR-H decoy launchers are positioned abreast the funnel on both sides of the ship. The antennas of various satellite communication systems are installed in the area between the exhaust funnel and the 76mm gun mounted on the starboard roof of the helicopter hangar. The ships also have two positions for rigid inflatable boats (RIBs) located to port and starboard of the main exhaust funnel. The 76mm gun on the helicopter hangar has an approximately 270-degree continuous firing arc thanks to its elevated position. The flight deck is located at the stern of the vessel and incorporates a Curtis-Wright TC-ASIST recovery system to assist safe handling and recovery. The ASW type ships have a variable depth towed sonar array housed in a room below the flight deck.

Italian FREMM frigates incorporate two 8-cell Sylver A50 VLS modules capable of launching 16 Aster 15 and Aster 30 missiles in total. Both FREMM types are fitted with the MBDA Teseo Mk 2/A surface-to-surface missile, which can be



*Two 8-cell Sylver A50 VLS Modules of Italian FREMM*

*Counter Measure Decoy & Weapon Systems*

used against both surface ships and coastal targets. Ships in general-purpose configuration can carry up to eight Teseo missiles. When necessary, the ASW type frigates can be deployed with half of this loadout, using the other four launchers for MILAS anti-submarine missiles.

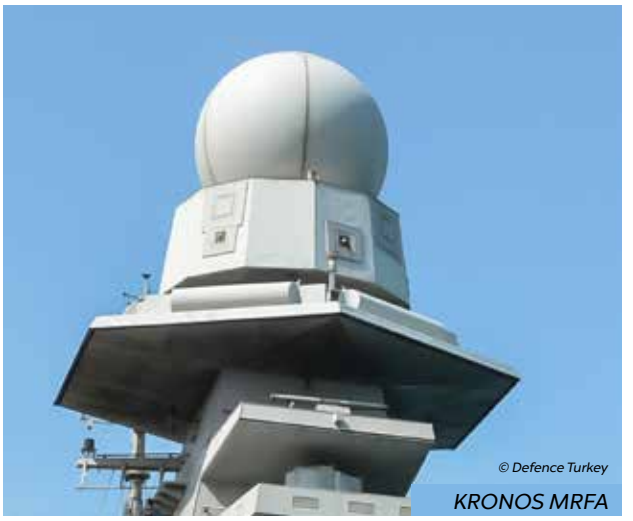
Both hull configurations look very similar in terms of their external appearance. The most significant distinction between the two types is the general-purpose ships use the new OTO Melara (now Leonardo) 127/64 Lightweight (LW) naval gun system capable of firing Vulcano extended range munitions. On the other hand, the vessels in the anti-submarine warfare configuration use the Leonardo 76mm/62 Super Rapid defense systems (STRALES) as their primary gun in place of the 127/64 LW gun.

For close-in ship defense, all FREMM frigates are equipped with one 76mm/62 Super Rapid defense systems (STRALES) naval gun and with a pair of Oto Melara Oerlikon KBA 25mm/80 guns that have limited air-defense capability. The 25mm autocannons on the last two ships of the class will be replaced with remote-controlled weapon stations. The manual mounts of the 25mm autocannons on the other vessels will also be replaced with remote-controlled systems in the future.

For anti-submarine warfare (ASW) operations, both vessel types are fitted with two Eurotorp/WASS (Leonardo) B513 324mm triple torpedo launchers for MU90 Impact torpedoes which are also used by the co-operating ASW helicopter.

The hangar on ships is large enough to accommodate two SH-90 helicopters (the name given to the NH-90 helicopters by the Italian Navy) or one SH-90 and one AW-101 helicopter. Helicopters are used for various missions, primarily the anti-submarine warfare.

The ships' primary sensor is the Leonardo Kronos Grand Naval (MFRA) Active electronically scanned array radar. The KRONOS radar family was created by the redesign of the Selex EMPAR naval radar following the purchase of Italian defence and electronics manufacturer Selex by Leonardo. The Kronos can identify and then track potential hostile targets out to a range of more than 300 nautical miles and can control engagements with Aster missiles, directing them towards the target via data uplink. The first eight ships are equipped with the SPS-791 air/surface surveillance radar, while the last two frigates have SPS-732. Additionally, each vessel is fitted with three SPN-753 navigation radars for safe navigation. The fire-control roles of the naval guns on the ships are carried out by two Selex MSTIS (multi-sensor target indicator system) NA-25XP radars.



*KRONOS MRFA*

For offensive anti-submarine operations and frigate self-defense, both types have Thales UMS 4110 CL hull-mounted sonar. The anti-submarine ships are also fitted with Thales UMS 4249 (CAPTAS-4) variable-depth sonar housed in a handling room below the flight deck. These systems form an integrated sonar suite with mine avoidance and echo sounding capabilities. With this integrated sonar suite, including B513 torpedo tubes and SLAT torpedo defense system, the ASW type frigates can effectively combat underwater threats.

Advanced protection systems are installed on Italian FREMM Class frigates for self-defense


© Defence Turkey

against modern threats. The primary electronic warfare system on ships is the MM/SMQ-765 system produced by the joint venture between the Italian Elettronica Group and French Thales. This system can conduct electronic attack (EA) against both the enemy's communication (C-ECM) and radar (R-ECM) systems. The main receiving antennas of the system are located just below the Kronos radar dome on the ship's mainmast. One of the antennas of the Nettuno 4100 system, which is used for jamming enemy communications and radar systems, is located aft of the ship's hangar on the port side, while the other is on the mainmast under the navigation radar. This system uses an active phased array transmitter.

Italy started the FREMM project together with France, however visually similar yet quite different ships were emerged according to the needs and budgets of both countries.

On April 30, 2020, the United States Navy announced that Italian Fincantieri won the FFG(X) Next-generation Frigate Competition with its solution based on the Italian Navy's FREMM class ships, which will be modified according to the specific requirements of the US Navy ■

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F-592 Carlo Margottini


# A Look at Ongoing MBT Upgrades & New MBT Programs in the Western World

İbrahim SÜNNETÇİ

**The Fire Power, Protection (Survivability) and Mobility defines the three basic characteristics of the Main Battle Tank (MBT) that first deployed in September 1916 and dominated battlefields throughout the rest of the 20th Century and beyond.**

Thanks to their survivability, long-range weapons, sensors and ability to deliver firepower accurately, the MBTs can support the infantry forces on the battlefield with instantaneous, accurate and direct fire support whenever and wherever it is needed either on the move or stationery.

As one of the many types of Armoured Fighting Vehicles (AFVs) found on the modern battlefield, tanks have been produced in all shapes and sizes throughout their 104 years of evolution but their ability of carrying firepower on the battlefield with a protected crew and weapons has remained essential.

Even though the obsolescence and death of the MBT have been declared many times before especially when the first ATGM was deployed at the battlefield in early 1970s, the MBT has repeatedly proven itself after each incidents and managed to survive, not vanquished though it was humbled with the introduction of wire-guided anti-tank guided missiles (ATGMs).

Since the deployment of first British Mark I heavy tanks (weighing 28 tonnes and powered by a six cylinder petrol engine generating 105hp it was the first operational tank in the British Army and in the world) at the battlefield during Battle of Somme in September 1916, there has been a race between tanks and anti-tank weapons. Even once the anti-tank weapons had the upper hand (at Yom Kippur War in October 1973 when the Israelis had suffered heavy tank losses due to Soviet-made man portable Sagger ATGMs and rocket launchers), thanks to deployment of advanced armour systems (including passive and reactive armour systems) and effective hard-kill Active Protection Systems (the APSs are indeed operational since December 1983 with Russian Drozd but they cannot be effectively used until necessary advancements had

achieved in computer and sensor technologies in 2000s) coupled with a Missile Warning System (MWS) such as Israel's Trophy System (ASPRO-A, adopted for use on the Merkava Mk4 in 2009 and tested by the IDF Ground Forces Command by firing a dud ATGM in December 2010 is able to detect, classify and engage all known chemical energy [CE] threats including; recoilless rifles, ATGMs, anti-tank rockets, HEAT tank rounds, and RPGs) the balance between tanks and anti-tank weapons have been restored during last decade. The Trophy APS deployed on Merkava MBTs during Gaza conflicts in 2011 and 2014 proved that it could prevent damage to tank from asymmetric threats, such as those from RPGs and ATGMs in urban areas and diminishes necessity for the integration of add-on armour kits which lead to increase in MBT total weight and profile. During the 2014 Gaza conflict, the Trophy APS destroyed around 15 ATGM's and RPG's shot at Merkava MBTs. Not a single ATGM hit a Merkava MBT.

It is widely accepted that the breakthroughs in anti-tank weapon systems development and ease of their obtainment have made the modern battlefield more dangerous than ever for the MBTs. Thanks to their ease of operation the third generation ATGMs are nowadays can be used with tactical skill, including "swarm" techniques (firing multiple ATGM rounds at the same target at the same time) at ambushes during MOUT-operations in Lebanon, Iraq, Syria and Yemen with few technical errors by non-state forces and terrorists. As it was proved in recent conflicts, unless they are equipped with state-of-the art technology and effective hard-kill Active Protection System (APS) coupled with a Missile Warning System (MWS) even the contemporary MBTs, featuring an innovative design that combines maximum fire-power and manoeuvrability with high crew safety, are still vulnerable on a battlefield in which long-range, advanced guided third generation ATGMs have proliferated.

During last decade at asymmetric MOUT (Military Operations on Urban Terrain) operations carried out in Iraq, Lebanon, Syria and Yemen, where the anti-tank guided missiles (ATGMs) have destroyed far more armoured vehicles than tank main guns have, the MBTs were increasingly deployed as a "direct fire support system" for deployed infantry forces. But as it was experienced with high loss records deployments of the MBTs in such role exposes high vulnerability especially against ATGMs as well as improvised explosive devices (IEDs) and mines. During recent conflicts many MBTs that utilized as a "direct fire support system" have been hit and knocked out of commission by second (such as TOW 2A) and third generation (such as Kornet-E) ATGMs used with asymmetrical warfare tactics.

Never the less at recent conflicts it was once again shown that contrary to ATGM, IED and mine threats the MBT is still a potent force and if fitted with an effective APS coupled with a MWS and utilized under true tactics (including improved cooperation with infantry to minimize exposure to long-range attacks) in the hands of well-trained, highly professional crew the awesome power of the MBTs have not yet superseded by any other weapon system on the battlefield.

It is clear that forces fighting today's conflicts, where the hybrid and asymmetrical warfare tactics are implemented, still need MBTs and heavy armour because the MBTs and heavy armoured formations are the only units able to manoeuvre on a battlefield where an adversary has an effective standoff weapons capability, particularly ATGMs.

## Will the MBT Continue to Play a Role on Tomorrow's Battlefields?

History of the late 20th and early 21th century has proven that the MBT still is the backbone of operations of Land Forces in symmetric as well as in asymmetric operations and will remain the central element of the ground force structure, with a continued role of primary importance in the future battlefield.

It is widely accepted by the experts that there is still a necessity for heavy armoured vehicles for ground combat in future's military strategy so the MBTs will still be around for their bi centenary in 2116. However, due to new and improved technologies the design of the future MBT in the western world would be completely different from current designs featuring stealth technologies, unmanned turret systems, active electric armour, electric or hybrid drive systems that reduce engine heat signatures, lasers and energy weapons.

## Recent Military Trends in MBT Field

While there has been a declining MBT market in West at the end of Cold War (as stated by the European Defence Agency the number of heavy tanks in the EU member states has fallen from 15,000 to only 5,000 since the turn of the millennium), this has not been the case in the Middle East and in the Far East countries such as China (China achieved the serial production of the Type 80 MBT that represents a major advances in Chinese tank design since it incorporates many developments including stabilization and computerized fire-control system in late 1980s and in early 1990s the Type 90-II MBT [also known as MBT 2000] appeared which incorporates considerable improvements in firepower, protection and mobility over previous Chinese MBTs), Japan (in 1990 Japanese consortium headed by Mitsubishi Heavy Industries started

*Mitsubishi Heavy Industries indigenous Type 90 MBT*

production of indigenous Type 90 MBT that is still in Japan Ground Self-Defence Force service but has not been offered for export) and the Republic of Korea (under a joint US-South Korean project entirely South Korean-built Type 88 K1 MBT was developed and entered Republic of Korean Army service in 1987 and first production vehicle of its improved variant dubbed K1A1 MBT that fitted with 120mm smoothbore main gun was produced in 1996) which have developed their own MBT building industries and manufactured indigenous MBT solutions some of which already succeeded to secure export orders.

Starting from the beginning of 2000s consideration has been given both to lighter, smaller and air transportable medium MBTs and AFVs with identical firepower to supplement heavy MBT fleets and fitting old tanks with more powerful guns, powerpacks, new generation optics and fire control systems, which in time turned into a big business all over the world. However, as a result of experiences gained during counterinsurgency (COIN) operations in Iraq and Afghanistan, where the threat mainly stemmed from lightly armed (main weapons against armoured vehicles were RPGs and IEDs and/or mines) opposition forces (insurgents/rebels) with poor tactics, conventional MBTs received further upgrade meant to keep them ahead of the threat. In this context MBTs were fitted with a 12,7mm Remotely Operated Weapons Station (to allow the commander to shoot at targets from the safety of inside the tank), underbelly mine protection kit (to counter the latest mine and IED threats), add-on armour kits at the front and sides (such as the brick-like M19 ARAT 1 and M32 ARAT 2 on M1A1/A2 Abrams) to improve protection against Rocket Propelled Grenades (RPGs) with shaped-charge warhead and a tank-to-infantry telephone (allowing tank crew to communicate with nearby infantry). Starting from 2014 opposition forces (non-state military forces and proxy fighters) in Syria, Iraq and Yemen gained some experiences (learn to utilize asymmetric warfare tactics against armoured vehicles in urban environment) and captured/taken over (from Syria or Iraq Government bases) or somehow obtained substantial amount of ATGMs, which allowed them to destroy many armoured vehicles including MBTs.

The US (provided weapons including ATGM missiles to rebels fighting the Assad regime and ISIS in Syria), Russia and Iran that send modern ATGMs along with other weaponry to arm and train proxy fighters and non-state actors have also played an important role in the proliferation of the modern ATGMs in recent asymmetric


*M1A2C SEPv3 with TROPHY APS*

MOUT operations in Iraq, Lebanon, Syria and Yemen. As a result of their efforts in a very short period of time the ATGM becomes the single greatest threat to MBTs in MOUT operations. The heavy losses of MBTs in recent asymmetric MOUT operations in Iraq, Lebanon, Syria and Yemen has proved that unless they are fitted with modern armour package (including both modular armour and cage/slat armour) able to cope with urban warfare threats and an effective APS the modernized 1960 and 1970-vintage MBTs (such as; T-55VM, T-62M, T-72AV, T-72M1, M60A3, M60T, Leopard 2A4 and Merkava Mk2 and Mk3) and even the contemporary MBTs with heavy thick armour (Merkava Mk IV, T-90A, M1A1, M1A2S and AMX-56 Leclerc) are vulnerable against ATGMs deployed with asymmetric warfare tactics. Contemporary Western world MBTs such as Challenger 2, Leopard 2A6, Leclerc, and M1 Abrams are indeed very effective tanks and could certainly outclass Soviet-era MBTs but they have had certain vulnerabilities (especially against ATGMs) exposed over the past few years during the asymmetric MOUT operations in Iraq, Lebanon, Syria and Yemen.

Conflicts in Iraq, Lebanon, Syria and Yemen have fostered willingness of customers to check and modernize their MBT inventory for adequate firepower, mobility and protection (including both armour upgrade and hard kill APS that is seen as an essential capability


in terms of protecting against modern threats) to cope with symmetric and asymmetric threats. In this context both the US (first batch order aimed to retrofit M1A2SEPv2 Abrams MBTs deployed in Europe but Trophy APS also included in SEPv3 upgrade) and Germany (one tank company it plans to deploy as part NATO's Very High Readiness Joint Task Force/VJTF) has stepped up their efforts to equip their M1 Abrams and Leopard 2 MBTs with Rafael's Trophy APS. Rafael successfully tested Trophy APS fitted to a German Army Leopard 2 MBT in 2019 summer. While Rafael completed the delivery of first batch of 29 Trophy APS to the US in September 2019, the German Army tank company unit is expected to receive the Trophy systems in 2022. The advantage of APSs, an additional safeguard for the crew, is that they are lighter than add-on armour kits, which cause increase in weight and profile of the MBTs.

The introduction of Armata combat platforms (T-14 Armata MBT, T-15 Heavy Armoured Combat Vehicle [ACV], and T-16 Tank Recovery Vehicle) by Russia in 2015 was a wake-up call to the Western world. Presented to the public for the first time at the Victory Day parade on Red Square on May 9, 2015, the T-14 MBT is equipped with fourth generation Malachit Explosive Reactive Armour (ERA) and the Afghanit APS, has fully digitized equipment (with a high proportion of software), an unmanned turret and an insulated armoured capsule for the crew. As the new future Russian MBT threat to the Western world the T-14 Armata MBT has caused a substantial step up both in MBT upgrade efforts and in the development of next generation MBTs in Western world.

As a response to the new Russian T-14 MBT and to meet the requirements for the immediate future (by 2030) many of the contemporary Western world MBTs such as M1 Abrams, Leopard 2A6, Leclerc and Challenger 2E are undergoing comprehensive high-tech upgrades that would turn them into a more reliable, effective and lethal and allowing them to be a key asset in the land portion of the evolving multi-domain battle. But even they receive comprehensive upgrade contemporary MBTs are still not quite the radical new MBTs that would meet the requirements of Land Forces/Armies in beyond the immediate future (after 2030). For this purpose, next generation MBT development programmes have been launched both in Europe and in the US, which is a subject of another article. France and Germany (Krauss-Maffei Wegmann, Nexter and Rheinmetall) are collaborating together to produce the next generation MBT under the MGCS (Main Ground Combat System) Project, which is at an initial stage and aims to replace both the German

Leopard-2 and the French AMX-56 Leclerc MBTs with a common design next generation MBT in about 2035. Germany is interested in acquiring more than 300 vehicles while France up to 250 vehicles. Polish MoD also declared its interest in joining the MGCS Programme in August 2019. Making the start of the MGCS procurement program KMW, Nexter Systems and Rheinmetall AG established an ARGE in December 2019. On April 28, 2020 Germany's Federal Ministry of Defense (MoD) announced on its website that German Defence Minister Annegret Kramp-KARRENBAUER and her French counterpart, Florence PARLY, have signed a Framework Agreement on the Franco-German Main Ground Combat System (MGCS) Project. In May 2020 under the MGCS Project the partners and the German Federal Office of Bundeswehr Equipment, Information Technology and In-Service Support (BAAINBw), acting in the name of Germany and France, have signed a contract for the "System Architecture Definition Study – Part 1 (SADS Part 1). This contract represents the industrial starting gun for a MGCS Demonstration Phase.

The US Army on the other hand is exploring next generation MBT concepts (including both manned and unmanned tank variants) as part of its Next Generation Combat Vehicle (NGCV) Programme to replace the M1A1 and M1A2 Abrams MBT fleet.

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*AMX-56 Lecler MBT*

## MBT Upgrades & New MBT Programs in the Western World

### AMX-56 Leclerc MBT

Under the Scorpion Programme the French Army will upgrade 200 (122 of which by 2025) of its some 406 third generation AMX-56 Leclerc MBTs, which entered the service in 1992, to the Leclerc XLR level to keep them ahead of the competition and to adapt them to ever-changing battlefield threats. The Programme also covers the upgrade of 18 Leclerc DCL/DNG (Armoured Recovery version of the Leclerc) battlefield repair tanks. Deliveries of the renovated Leclerc XLR MBTs and Leclerc DCL/DNGs to the French Army will take place during 2021 and first brigade to be equipped with Griffons, Jaguars and renovated Leclerc XLR MBT is scheduled to be operational in 2023. The Scorpion renovation, which is scheduled to be completed by 2028, will allow the Leclerc XLR MBTs and Leclerc DCL/DNGs to remain operational until at least 2040.

Notified in March 2015 to Nexter Systems for € 330 Million the Leclerc XLR renovation will be materialized in 2020 by a first order for 50 platforms. Ultimately, the French Army would receive 200 upgraded Leclerc XLR MBTs, 122 of which by 2025. The Leclerc XLR renovation aims to increase the Leclerc MBT's operational capabilities to allow them to operate better in an urban environment during MOUT-operations, with the integration of new open vetronics architecture, new armour kits (that includes additional modular thick passive armour on the hull and the slat armour on the rear part of the hull and turret), the BARAGE jamming system, a new programmable 120mm ammunition (called 120 mm HE M3M) and secondary armament (a new 7,62mm remotely-operated weapon system from FN Herstal) on the top of the turret, as well as the CONTACT radio currently developed by Thales and the French Army's new command and communication systems (Scorpion information and communication system [SICS] provided by Atos. The Leclerc DCL/DNG will be integrated with the SICS screen and will receive a rear armour and a Scorpion T1 cupola with a 12.7 mm machine gun.

Meanwhile, according to reports Nexter Systems has been testing a modified Leclerc MBT with a 140mm main gun as part of the development of a MGCS Programme, of which one of requirement is to have at least 50% more capable main gun than the existing 120mm main guns on Leclerc and Leopard 2 to cope with future threats (such as T-14 Armata's future 2A83 152mm main gun and new armour system). The up-gunned Leclerc has fired more than 200 140mm rounds successfully and Nexter Systems claims the weapon is 70% more effective than existing NATO-standard 120mm tank main guns.

## European Main Battle Tank

The European Main Battle Tank, or EMBT, combines the KMW Leopard 2A7 MBT's chassis fitted with the Nexter Systems Leclerc MBT turret. Since the Leclerc MBT's turret fitted with an auto loader is lighter and more compact than the one on Leopard 2A7, the combat weight of the EMBT has been reduced by roughly 6 tonnes. The chassis and turret sections were integrated at Nexter's facility at Roanne, where Leclerc MBT production was originally undertaken. According to Krauss-Maffei Wegmann + Nexter Defence Systems (KNDS), the hull, engine and entire chassis comes from the Leopard 2A7 and were modified to host the compact and light turret with automatic loading from the Leclerc. As their first joint product the EMBT prototype (a technology demonstrator) unveiled by the recently formed KNDS Group during Eurosatory 2018 and has been evaluated as a starting point for the MGCS since it stands as a solid prove that French and German industries can work together on joint MBT project. The EMBT prototype has been readied for initial testing within a record time of 15 months following initial talks between the two companies. The EMBT is planed first for the export markets and according to French media reports, Italy has already expressed interest. Designed to be a short-term response to the operational need of the market for high-intensity MBTs able to operate better in an urban environment during MOUT-


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operations the EMBT is expected to be in service by 2022 if there would be a buyer. Depending customer requirement the EMBT shall in the future also be equipped with a more powerful 130mm/ L51 smoothbore gun. With the new 130mm main gun, the EMBT would be able to face off Russia's T-14 Armata MBT. However, there is doubt that the EMBT will become a serious product in the immediate future (by 2030).

## C1 Ariete MBT MLU Program

In early February 2020 the Italian Ministry of Defense announced that they have signed a Euro35 Million contract in August 2019 with a consortium of Iveco Defense Vehicles and OTO Melara (CIO Consortium) for the Mid-Life Upgrade (MLU) of three Ariete C1 MBTs at the Leonardo plant in Spezia and Iveco in Bolzano. Being financed through the Ordinary Budget

of the Italian Ministry of Defense the contract has three-year schedule (2019-2021). The upgraded C1 Ariete MBTs will play the role of prototypes for a new variant of this tank and to be tested in Italian armored units in 2021.

The C1 Ariete MBT entered service at Esercito Italiano (Land Forces of the Italian Armed Forces) in 1995. During 1995-2002, Italian Land Forces took over 200 Ariete tanks, which went to the 4th, 31st, 32nd and 132nd Armored Regiments. According to open sources following the successfully completion of prototype phase at Serial Modernization Phase 150 to 200 C1 Ariete MBTs in the service of four land regiments will receive MLU modernization which will allow the extension of their operational life to 2035.

Improving mobility and operability with other Italian combat vehicles were identified as the most priority aspects of the MLU effort. Therefore, as part of the Mid-Life Upgrade, the Ariete MBT will receive improved suspension system and a new power-pack consisting of a 1,500hp Iveco VECTOR 12, 12-cylinder diesel engine, and a Renk HSWL 295TM automatic transmission (in place of the FIAT-Iveco MTCA 12V 1,270hp engine and ZF Friedrichshafen LSG3000 automatic transmission). The Renk's HSWL 295TM


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*C1 Ariete MBT*

automatic transmission already present in the K2 and ALTAY MBTs, and the VECTOR 12 engine will use common components with the VECTOR 8 engine present in B2 Centauro II Main Gun System (MGS), wheeled tank destroyers.

The upgraded C1 Ariete MBT will incorporate the upgraded Selex Galileo TURMS-T (Tank Universal Reconfiguration Modular System) Fire Control System, coming from B2 Centauro II MGS, such as the ballistic computer and optoelectronic systems: the Lothar sight and the ATTILA-D panoramic sight periscope. In addition, the electrohydraulic drive system of the tank turret will be replaced by an fully electrical one. The crew will also have new radio stations at their disposal. Witihin the scope of MLU the C1 Ariete MBTs will also receive easily disassembled passive shield modules at the front of the vehicle and ROMOR reactive armor, which will appear on the sides of combat vehicles, and will be equipped with a new fire protection system located both in the turret and in the hull.

## M1A2 SEPv3 (designated M1A2C) Abrams MBT

As part of its 2028 vision the US Army is upgrading its Abrams MBTs to M1A2 System Enhancement Package Version 3 (SEPv3, also known as the M1A2C) level, the most modernized M1A2 Abrams MBT configuration, to improve the vehicle's lethality, survivability, responsiveness, power

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*M1A2 MBT*

generation, sustainability, and maintainability. The M1A2 SEPv3 replaces the M1A2 SEPv2, which was implemented during 2005 and 2015 and entered the US Army service in 2007. In accordance with the national direction the US Army has been shifting its focus from counterinsurgency (COIN) operations to conventional warfare focusing against great powers during recent years. In parallel to this focus shifting process it seems that even it features some new capabilities focusing on asymmetrical warfare, the M1A2 SEPv3 upgrade has been mainly oriented towards full-scale tank-to-tank battle (has thick add-on armour blocks on the front of the turret face) or a mechanized warfare against great-power adversaries such as Russia (has been working on a fleet of upgraded tanks, as well as continuing to work on the new T-14 Armata MBT) and China (has been developing new MBTs with better armour protection and electronics). The driving force behind this focus change appears to be Russia's new T-14 Armata MBT and Russian ground forces involvement in the occupation of Crimea. The US Army will likely send one of the M1A2 SEPv3 equipped armoured brigades dubbed Armoured Brigade Combat Team (ABCT) to Europe soon, because the M1A2 Abrams is the US Army's most powerful weapon in a potential ground conflict in Europe.

Production for the M1A2C is being conducted at the Joint Systems Manufacturing Center (JSMC, a Government owned manufacturer run by GDLS in charge of the upgrade program) in Lima, Ohio and at the Anniston Army Depot in Anniston, Alabama by using existing M1A1 and M1A2 Abrams MBT hulls as a starting point. Prototypes of the M1A2C MBT began testing in 2015 and deliveries to the US Army began on 4 October 2017 as part of a US$92.2 Million contract awarded to GDLS in December 2015 to convert an initial batch of six tanks to the new standard. GDLS received follow-on contracts in 2017 (US$270 Million for 45 tanks with delivery between July 2018 and August 2019) and in 2018 (100+174, sufficient to arm three ABCTs). In December 2017 the US Department of State awarded a framework contract to General Dynamics Land Systems (GDLS) to upgrade up to 435 M1A2 Abrams MBTs to the M1A2C SEPv3 configuration. With current orders the JSMC production line will be kept running through 2021. The JSMC has completed delivery of the first full brigade (armoured brigade dubbed Armoured Brigade Combat Team [ABCT], each has 87 Abrams MBTs along with Bradley ACVs and Paladin SPHs) of upgraded M1A2 SEPv3 Abrams MBTs in 2019 summer. At present, each V3 upgrade costs around US$4 Million and each M1A2 SEPv3 MBT costs around US$20 Million. The price should drop as the production rate increases. The US Congress allocated US$1.5 Billion in FY19 to the US Army for the upgrade of 135 M1A2s to M1A2C level, further 299 M1A2C upgrade is slated for between FY20 and FY23 via the base budget.

The M1A2 SEPv3 includes; Joint Tactical Radio System (JTRS, to support the JTRS' digital data links the SEPv3 has an ethernet architecture and better Line Replaceable Unit [LRU]/ Line Replaceable Module [LRM] design), improved main gun accuracy with "smart cannon" munitions (such as M829A4 Advanced Kinetic Energy and XM1147 Advanced Multi-Purpose [AMP] rounds) programmable over Ammunition Data Link (ADL), Trophy hard-kill APS (mounted on large external protrusions on each side of the turret to defeat enemy anti-tank weapons including ATGMs and HEAT tank rounds), a built-in jammer (AN/ VLQ-12 Counter RCIED) for defeating radio-triggered IEDs, Armour Upgrades (the SEPv3 has thicker front and rear armour than the SEPv2 and there are geometric changes on the turret), improved forward-looking infrared (FLIR) sensor using long- and mid-wave infrared, a low-profile Common Remotely Operated Weapon Station (CROWS), a new 1,000-amp Power Generation and Auxiliary Power Unit (APU, allows crew to monitor the battlefield silently for hours) installed underneath the armour to run tank's electronics without turning on the main engine. The M1A2 SEPv3 is still under 70 tons but could grow heavier with future upgrades.

While the deliveries of M1A2 SEPv3 are on-going work on development of the next M1A2 Abrams upgrade configuration, dubbed M1A2 SEPv4, has already begun. For this purpose, the GDLS was awarded a US$310.6 Million contract modification in August 2017 for the development of seven prototype M1A2 SEPv4 MBTs (also knows as the M1A2D) and testing. The new M1A2 SEPv4 MBT configuration, planned to be tested by 2021, will include new laser rangefinder technology, colour cameras, integrated on-board networks, new sliprings, advanced meteorological sensors, ammunition data links, laser warning receivers and a more lethal, multi-purpose 120mm ammunitions. The M1A2 SEPv4 MBT production is set to begin in FY23, with fielding taking place by FY25.

*Leopard 2A+7 MBT*

## Leopard 2A7+ and Leopard 2A7V MBT

First shown to public during the Eurosatory 2010 the Leopard 2A7+ is a modernized version of the Leopard 2A6 MBT developed by KMW. Designed to operate in low intensity conflicts and also in high intensity conflicts the Leopard 2A7+ features enhanced protection and reconnaissance capabilities. Tested and qualified by the German Army the Leopard 2A7+ main battle tank is equipped with a modular protection kit with passive armour modules to offer 360° protection to the crew from ATGMs, mines, IEDs and RPGs threat. Ordered 62 Leopard 2A7+ MBTs under a US$2.21 Billion contract awarded in 2013 Qatar received the first batch in October 2015 and the second batch of Leopard 2A7+ MBTs in October 2016. On 19 December 2018, as part of its modernization process, Hungary signed a contract with KMW for the procurement of 44 new Leopard 2 A7+ MBTs with deliveries scheduled between 2021 and 2025.

Powered by an MTU MB 873 diesel engine, which generates a power of 1,500hp, the Leopard 2A7+ is equipped with the Rheinmetall 120mm L/55 smoothbore gun, a computerised fire control system coupled to day and thermal sights for the commander and gunner, the latest armour package, an air-conditioning system and a roof-mounted 12.7mm FLW 200 RCWS to provide a close-in self-defence capability.

Unveiled first at Eurosatory 2016 the Leopard 2A7V (Verbessert – "Superior") is the latest version of the Leopard 2 MBT family. Compared to Leopard 2A7 version, the Leopard 2A7V is fitted with a new armoured modular system for the upper front glacis plate of the hull, features a more powerful (20kW) Auxiliary Power Unit (APU), a new Thales SOTAS intercom, air conditioning system, integrated with third generation thermal imagers and a laser range finder, capable of using Rheinmetall's new programmable DM11 multipurpose round with modernized RH-120 L55A1 main gun which is able to fire the latest generation of armour piercing ammunition in the upper pressure zone, more powerful guidance drives an a new cooled thermal imaging rear camera for the driver.

The German Federal Armed Forces (Bundeswehr) will receive a

total of 205 Leopard 2A7V MBTs being modernized by KMW and Rheinmetall under two existing contracts with a total value of more than EUR1 Billion. They will be used in the modernization of four tank battalions in the near future. Two more tank battalions will continue to operate the older Leopard 2A6s with about 90 tanks. 32 obsolete Leopard 2A4 MBTs, on the other hand, will be sent for storage. On 29 October 2019 KMW handed over first of 104 Leopard 2 MBTs upgraded to the A7V standard to the German Federal Armed Forces (Bundeswehr) and first Leopard 2A7 MBT to the Danish Army at a ceremony held in Munich, Germany. The Danish Army will receive a total of 44 Leopard 2A7 MBTs by 2022. The Bundeswehr will receive the remaining Leopard 2A7Vs by 2023. The contract valued at US$843 Million (EUR760 Million) was inked in April 2017 and covers the upgrade of a total of 68 Leopard 2A4s (Strv 121s repurchased from Sweden), 16 Leopard 2A6s (acquired from Denmark) and 20 Leopard 2A7MBTs to the A7V standard. The Leopard 2A7Vs are expected to be replaced with the promising MGCS MBT in mid 2030s. On 20 March 2019 the Bundestag Budget Committee of the German Parliament, approved EUR25 million (US$28 million) of funding to upgrade 101 German Leopard 2A6M2 and Leopard 2A6 MBTs to a level to the Leopard 2A7V. The total value of the upgrade programme is EUR300 Million and will be shared by KMW and Rheinmetall. Modernization of the second batch of 101 Leopard 2A7Vs is scheduled to be completed between 2020 and 2026.

*The Challenger 2 LEP Advanced Technology Demonstrator of RBSL*

## Challenger 2 Life Extension Program

The Challenger 2 (CR2) MBT is in service with the British Army since 1994 and had its first combat experience during the 2003 Iraq War, where it engaged mainly with Soviet-era T-72s upgraded by the Iraqi military. The UK Ministry of Defence (MoD) has launched Challenger 2 Life Extension Programme (LEP) to modernize tanks with new night combat capabilities and equip with Active Protection System (APS) to ensure the Challenger 2 MBT remains combat-ready for the next 20 years until 2035. Under the Programme the UK MoD awarded separate £23 Million contracts on 22 December 2016 to BAE Systems and Rheinmetall Land Systeme for the assessment phase of the Challenger 2 LEP.

To bid for the Challenger 2 LEP BAE Systems has developed the Black Night Challenger 2 Technology Demonstrator equipped with a Safran Paseo commander's independent sight, Leonardo thermal imager for the gunner, and Leonardo night sight DNVS 4 to provide hunter-killer thanks to thermal imagers for the gunner, commander, and driver. The Black Night Challenger 2 unveiled by BAE Systems in September 2018 retained the tank's L30A1 120m rifled gun.

However, the other bidder Rheinmetall Land Systeme offered a more extensive modernisation that includes the RH-120 L55A1 120 mm smoothbore gun. On 1 July 2019, Rheinmetall Defence UK (55%) and BAE Systems Land UK (45%) formed a new UK-based joint venture company dubbed RBSL. Headquartered at the BAE Systems factory in Telford, RBSL unveiled its proposal for the Challenger 2 LEP at DSEI 2019 Fair held in London during 10-13 September 2019. The Challenger 2 LEP Advanced Technology Demonstrator publicised by RBSL at DSEI 2019 features a brand new welded turret incorporating the Rheinmetall's L55A1 smoothbore gun (able to fire DM63A1 APFSDS-T KE and DM11 programmable High Explosive (HE) tank rounds), fitted with a fully digital electronic architecture and a computerised fire control system, all-electric gun control equipment, a Thales Orion panoramic day and night sight for the commander and a Thales DGNS T3 day and night sight for the gunner. The Challenger 2 LEP upgrade is also expected to be fitted with a hard-kill APS and RF Jammer for defeating radio-triggered IEDs. RBSL is now the only contender for the project. The UK MoD is expected to announce its decision under Challenger 2 LEP in early 2021 and since the Army 2020 Refine (the implementation of the UK Government's Strategic Defence and Security Review commitments) announced in 2016 reduced the number of tank regiments to two only about 150 Challenger 2 MBTs are now expected to be modernized.

## ALTAY Project Phase-II Serial Production Project

BMC was assigned as the Main Contractor upon the decree of the Defence Industry Executive Committee (DIEC, the highest decision-making body on defence procurement in Turkey) dated 29 March 2018 under the ALTAY Project Phase-II Serial Production Project. The contractual

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*ALTAY T1 MBT*

negotiations were launched in March 2018 with the company and were completed successfully. The contract valued at Euro 3.5 Billion was signed between the Presidency of Defence Industries (SSB), the procurement authority under the Turkish MoND and BMC on 9 November 2018. Under the Serial Production Phase, a total of 500 ALTAY MBTs are expected to be procured in two batches. The first batch of the ALTAY MBT Serial Production Phase, for which the contract was awarded, covers the production of a total of 251 ALTAY MBTs in three configurations. Of the 251 ALTAY MBTs under the contract, 40 will be in T1, 210 will be in T2 and 1 will be in T3 configuration. Under the Project, BMC was planned to receive consultancy services from Rheinmetall. According to BMC, Rheinmetall's consultancy would focus on various points being handled by their subcontractors, and which constitute the industrialization aspect of the Project.

The T1 variant, which will have similar features with the PV-1 and PV-2 prototypes developed and manufactured by Otokar but will feature the AKKOR Active Protection System (APS) and an improved add-on armour package from Roketsan (including slat armour at the rear of the turret and the hull, thicker ERA elements at the side skirts of the hull and an add-on armour kit over the turret) is scheduled to be in service with the Turkish Land Forces 18 months following contract effectivity. As of May 31, 2020, the contract still has not entered into effect.

Before the contract effectivity two important drawbacks should have been solved. The first one is the approval of the export license by the German Government for the export of the EuroPowerpacks for the ALTAY T1 MBTs to Turkey. The second one is the selection of the facility where the Serial Production will take place. As of May 2020 Turkey, still awaits approval of the export license by the German Government. Spoke to Bloomberg News Agency on 13 December 2019 regarding ALTAY MBT Programme President for Defence Industries Ismail DEMIR said; "While Turkey is awaiting to hear from Germany for the supply of an engine for its ALTAY MBT, it is also looking for alternatives." On May 28, 2020 speaking at the online panel organized by SETA Foundation DEMIR underlined that the ALTAY MBT Serial Production Phase will be started with available power-packs. DEMIR, "Work continues in two different power groups. We are talking about a process that goes by putting these studies on top of each other and that not only the power system but also a series of its components are developed together. In this sense, our companies have created a certain competence, they have accumulated. On the other hand, they carried certain collaborations to certain maturity, especially in terms of the earlier production of the tank. The level of maturity is in a very good condition, but I do not want to say it before the exact signatures are made and announced. However, I can say that we are at a good point there. In addition, we have a small number of spare engines. Starting with these, we will enter a certain tank production process. They will be produced until the other domestic solution comes into play." Under a Euro12 Million contract awarded on October 15, 2010 a total of 5 sets of EuroPowerpack, incorporating V-12 type MTU MT883 Ka-501CR diesel engine (27,35 litres, dry weight is 1,800kg) coupled to RENK's HSWL 295TM automatic transmission (with 5 forward and 3 reverse gears, dry weight is 2,450kg) and a cooling and air filtration system. ALTAY pre-prototypes (MTR and FTR) and prototypes (PV-1 and PV-2) are powered by EuroPowerpacks mounted in a 'U Configuration'. But since one of these 5 sets was funded by Otokar's own budget and installed on company's own ALTAY prototype the company did not deliver it to the SSB at the end of the first phase of the ALTAY MBT Program. Spoke to Habertürk News Agency on 17 December 2019 regarding ALTAY MBT Programme, Ethem SANCAK, Chairman of the Board of BMC, disclosed that they had 20 engines being utilised at test and trials so they would manufacture 20 ALTAY MBTS with those engines. However, spoke to media at a press conference organized on January 6, 2020 at the SSB

Headquarters SSB DEMIR underlined that they had 4 power-packs from the ALTAY MBT Prototype Phase, but they would not be sufficient to open a production line for the first batch of ALTAY T1 MBTs. DEMIR said, "We have a contract for the ALTAY MBT, such as T0 + 18 Months. T0 (contract effectivity) is the next stage for us, after the prerequisites are met and ready for production. The company cannot start the T0 when it does not have a power pack (motor and transmission). In the event that the application for the power package is not finalized, this 'T0-month' period does not start, as we could not start the T18. We had 18 months before we made public, we waited for the previous application to be concluded. This application has not encountered a positive or negative answer at this time and is pending. However, our search for alternatives for the power pack is continuing rapidly, and we hope that it will end soon. After the power package is completed and the production line qualification is completed, the T0 phase will start, and then we will start 18 months."

Meanwhile under an agreement between Military Factory and Shipyard Management Incorporated Company (ASFAT Inc.) and BMC, Serial Production of ALTAY MBTs will take place at the 1st Main Maintenance Factory Directorate in Arifiye, Adapazarı. The 1st Main Maintenance Factory Directorate (formerly known as 1st Main Maintenance Centre) in Adapazarı was operated under the MoND-controlled General Directorate of Military Factories (AFGM) when the Turkish Government decided to privatize and lease it to the private company BMC in December 2018. However, since this decision drew strong criticism in Turkish public opinion in the end in August 2019 it was decided to transfer the 1st Main Maintenance Factory Directorate to ASFAT Inc. Since its purchase by Turkish and Qatari partners for US$ 360 Million following a tender held in early 2014, BMC has been working as part of the strategic partnership between Turkey and Qatar. Since BMC has committed to manufacture 6 ALTAY MBTs per month during the Serial Production Phase, modern benches to enable the company to achieve this production rate will be required. For this purpose, BMC will invest up to US$50 Million in the 1st Main Maintenance Factory Directorate to upgrade its manufacturing infrastructure with the installation of new generation benches at the facility.

*MTU 1,500hp EuroPowerpack*

The ALTAY MBT T2 configuration will feature an increased armour system, increased protection with the isolation of ammunitions from the hull, laser guided tank ammo firing capability (for this Fire Control System should be upgraded), crew training mode and mobile camouflage net. The T2 variant is expected to begin deliveries shortly after the T1 configuration of ALTAY MBTs have been handed over. According to BMC officials, in order to compensate for the increase in weight, an indigenous diesel engine being developed by BMC Power for the ALTAY T2 MBT will be more powerful and will offer better performance than the existing 1,500hp EuroPowerpack.

*ALTAY MBT Loader with SARP RCWS operator console*

Only one ALTAY MBT prototype will be produced in T3 configuration, which will feature an unmanned turret with a bustle-mounted autoloader. The ALTAY MBT T3 configuration is scheduled for qualification in 2024, and it is understood to be intended for use in further trials and technical evaluations rather than for service with the Turkish Land Forces. The ALTAY MBT Serial Production Phase contract also includes lifecycle logistics support service and the establishment and operation of a Tank Systems Technology Centre. There is also a plan for the procurement of 60 Armoured Recovery Vehicle (ARV) and 50 Mine Clearance variants of the ALTAY MBT, which will be based on the T1 configuration's chassis.

BMC signed a contract on the ALTAY MBT Power Pack with the SSB on 13 June 2018. The name BATU was given to the ALTAY MBT Power Pack to incorporate a diesel engine and automatic transmission that will be developed by BMC Power. According to sources new engine with a power capacity of 1,600hp to be developed with Fiat's technical support will be based on the Fiat/Iveco MTCA V12 diesel engine generating 1,270hp (950kW) and has 25.8lt

volume utilized in the Ariete MBT. The engine that BMC will utilize in the ALTAY MBT will feature a turbocharger for the higher power requirement.

The ALTAY MBT is operated by a crew of four, consisting of a commander, gunner, loader and driver. The commander is seated on the right side of the turret, with the gunner forward and below his position and the loader on the left side of the turret. The commander's panoramic periscope mounted in front of the loader's hatch. The tank's main weapon is a 120mm 55-calibre smoothbore gun fitted with a thermal sleeve; fume extractor and a muzzle reference system. Ready to use 120mm ammunition is bestowed in the turret bustle with blow out panels in the roof. The loader's hatch has a ring mount for a 7,62mm machine gun, and Aselsan's SARP Remote Controlled Weapon Station (RCWS), armed with .50-calibre (12,7mm) machine gun, is mounted on the left side of the turret roof (behind the loader's hatch), for operation by the commander. The ALTAY MBT measures 10,85m in length, 3,68m in width and 3,32m in height, with a combat weight of 63,5 tons. Thanks to its powerful EuroPowerpack, ALTAY MBT accelerates from 0 to 32km/h (0 to 20mph) in 6 seconds and attains a maximum speed of 65,5km/h, the speed and agility also helps to improve survivability. The ALTAY MBT can cruise at 450km with internal fuel.

The 3rd+ Generation ALTAY MBT also was proposed for the Royal Army of Oman (RAO)'s Modern MBT tender covering the procurement of 76 tanks by Otokar. Currently RAO operates Challenger 2, M60A1 and M60A3 MBTs.

*The modernized FIRAT M60-T MBTs*

## M60 and Leopard 2A4 MBT Modernization

Soon after several Turkish M60A3, M60T and Leopard 2A4 MBTS were hit by Kornet-E/AT-14, Milan, TOW-II, 9K115-2 Metis-M and Fagot/AT-4 Anti-Tank Guided Missiles (ATGMs) launched by Islamic State (ISIS) and YPG/PKK militants during Operation Euphrates Shield (carried out during August 24, 2016 – March 29, 2017) in Syria, in January 2017 the Turkish Presidency of Defence Industries (SSB) launched a tender for the modernization of 169 M60T, 40 M60A3 and 84 Leopard 2A4 MBTs to improve their protection level and increase their survivability against modern ATGM threats.

The FIRAT-M60T Modernization Project was launched for the modernization of M60T MBTs to increase their survivability against modern ATGM ATGM (Anti-Tank Guided Missile) threats, to increase their firepower and their situational awareness. The Main Contract valued at EUR 109,245 Million + TL 25 Million was signed between the SSB and Aselsan on 11 May 2017, and the Amendment no 1 to the contract valued at EUR 96.7 Million + TL 25 Million was signed on 24 July 2018. Under the FIRAT-M60T Modernization Project, the Main Contractor Aselsan, in cooperation with the 2nd Main Maintenance Factory Directorate, integrated a 12.7mm SARP RCWS, YAMGÖZ Close-Range Surveillance System (360° Situational Awareness System), Tank Laser Warning Receiver System (TLUS, to detect, classify, identify and give warning of laser threats aiming on the platform such as; Laser Range Finders, Laser Designators and Laser Beam Riders), Tank Driver Vision System (TDVS), Smoke Grenade Launchers, Air Conditioning System, Auxiliary Power Unit (APU) and Audible Warning System and Protective Coating (at the turret walls and ceiling, to maximize crew protection from possible shrapnel threats encountered in the event of RPG and ATGM attacks) on 169 M60T MBTs in the TLFC inventory. In April 2018 the President of Defence Industries Ismail DEMIR announced with a tweet that under the FIRAT-M60T Modernization Project, delivery of the 90 40mm Automatic Grenade Launchers (AGL) had been completed. 40mm AGLs are integrated on SARP RCWSs and replaced the 12,7mm machine gun. Aselsan in cooperation with MKEK developed 40mm smart grenade munitions with airburst functionality and performed firing tests in April 2018. Some


*M60TM with AKKOR PULAT APS Counter Measure Modules*

of the modernized M60Ts dubbed M60TM, were deployed during Operation Olive Branch that was launched on January 20, 2018 against YPG/PYD positions surrounding the Syrian city of Afrin.

With the Contract Amendment no 1, the total amount of the Project contract has reached to EUR 206 Million + TL 50 Million. In accordance with the amendment to the contract, the AKKOR PULAT Active Protection System (APS) will be installed on 40 of the 169 M60TM MBTs tanks. Out of the 169 tanks named M60TM that were modernized as part of the FIRAT-M60T Project, the Telescopic Periscope System (TEPES) will be installed on 73 of these tanks. Moreover, 90 40mm automatic grenade launchers were procured in 2018 to be used on the M60TM MBTs.

AKKOR PULAT APS is capable of physical destruction and it is able to simultaneously cope with multiple threats and it provides 360-degree protection capability. The system detects RPGs and ATGMS directed towards the M60TM AMT in the air with the help of the high technology radar it features and destroys them at an optimum distance before they hit the tank. Aselsan displayed the M60TM AMT equipped with the AKKOR PULAT APS in the outdoor exhibition area during IDEF '19. According to the information on the product's brochure,

*From top to the bottom YAMGOZ Close-Range Surveillance System sensor, Tank Laser Warning Receiver System (TLUS) sensor and AKKOR PULAT APS Counter Measure Module*

the AKKOR PULAT APS contains three critical sub-systems: The Control Panel, Power Distribution Unit and the Counter Measure Module. Maximum 8 Counter Measure Modules that consists of a millimetre-wave Triggering Radar and Counter Measure Munition can be installed on every MBT. However, according to feedback given by the Turkish Armed Forces, and as no Counter Measure Module deployment was planned over the turret, only 6 Counter Measure Modules (2 on each of the sides, 1 on the front and 1 at the rear) exist on the M60TM. The system can be switched on and off with the help of the Control Panel in the driver's cab and the Counter Measure Modules can be activated upon request only towards the direction of the threat while other Modules can be deactivated. When the module is activated, the Counter Measure Munitions over it, in the form of a cylindrical stick, emerges out of its socket and remains outside the hull at a distance of 30-40cm. The sensor of the Triggering Radar remains on the tip of the cylindrical Counter Measure Munitions. The Triggering Radar is able to scan up to 180 degrees in azimuth and 35 degrees in elevation and is said to be capable of detecting an approaching threat up to 50m and calculates its angle of approach. After the estimation of the optimum intercept point, when the threat is within the range the warhead right at the back of the millimetre-

wave Triggering Radar is activated for interception. When the cylindrical Counter Measure Munitions is activated it neutralizes the threat using a dense cloud of fast-moving splinters (small fragments scatter around in the shape of a ring due to the cylindrical form of the munition). The fast-moving splinters directly shoots the warhead of the ATGM that constitutes a threat. After a physical impact either the warhead on the threat is disabled or the formation of the gel effect (in the HEAT type warhead) is prevented. According to Aselsan official as the fast-moving splinters moves 35 degrees upwards after the activation, it can, technically, also intercept ATGMs with a top attack capability to a certain extent. In one of his remarks, the former Turkish Minister of Defence Nurettin CANIKLI stated that interception up to 8-10 meters was possible with AKKOR PULAT while with AKKOR APS interceptions up to a distance of 100 meters of could be conducted. In the field tests executed with AKKOR PULAT APS, over 400 ballistic tests were conducted against various threats such as RPG, Kornet-E, Konkurs and TOW. During Operation Peace Spring, which began on 9 October 2019, the AKKOR PULAT APS on the M60TM MBT has proved its value and protected the tank and its crew against an ATGM shot by YPG.

With the help of the Telescopic Periscope System (TEPES) integrated


on the M60TM AMTs, secure surveillance and target acquisition capabilities while in the defilade position are gained. On account of Aselsan's TEPES mast mounted sighting system, which is to be integrated to a total of 73 M60TM AMTs, the tanks gain superior target acquisition and surveillance capabilities with high precision under all types of weather and geographical conditions. The capabilities of TEPES such as motion detection, target tracking, sectoral scanning, integrated operation with other systems (Laser Warning System, Remote Commanded Weapon System, etc.), acquisition of the target coordinates and video/ image recording will dramatically increase the survivability of the M60TM. The system capable of capturing thermal images and TV images via its E/O sensors is capable of conducting laser distance measuring up to 20 kilometres. TEPES can reach a height of 2.5 meters with the telescopic elevation system (mast) over the M60TM turret and is capable of calculating the coordinates of the target detected through INS integration and then submits them to the operator.

Roketsan and Aselsan have been selected for the modernization of M60A3 MBTs. With modernization undertaking, the aim is to increase the survivability, the firepower and the situational awareness of 40 M60A3 MBTs (sufficient to equip one tank battalion) in the Turkish Land Forces service. Dubbed the M60A3T1, the modernized M60A3 MBTs are integrated with a 12.7mm SARP RCWS, YAMGÖZ Close-Range Surveillance System (360° Situational Awareness System), Tank Laser Warning Receiver System (TLUS), Smoke Grenade Launchers, Tank Driver Vision System (TDVS), Fire Extinguishing – Explosion Suppression System, Audible Warning System, Power Distribution Unit, Protective Coating and Increased Armour Protection (Roketsan's add-on ERA armour modules and slat armour at the rear of turret). M60A3T1 MBTs will be also integrated with Aselsan's AKKOR PULAT APS. Photos of the modernized M60A3T1 MBTs were posted on social media/ twitter accounts in March 2018.

BMC was selected for the modernization of 84 Leopard 2A4 MBTs (sufficient to equip two tank battalions/one brigade) under different categories and a contract (according to sources valued at around US$300 Million) was signed in 2017 between BMC and the SSB. But according to a BMC official, as a result of the constantly changing requirements of the end user the Project has evolved into a completely different point. Required modifications and evolutions to answer the TAF's new requirements, that occurred during recently gained operational experiences, have been implemented on the Project structure and modernization efforts on prototype Leopard 2A4TM were launched in 2018. Modernization of the prototype Leopard 2A4TM was expected to be completed in 2019 and then Serial modernization of the remaining 83 MBTs will be initiated (either at the 1st Main Maintenance Factory Directorate or at the 2nd Main Maintenance Factory Directorate).

*T-14 Armata MBT*

## T-14 Armata MBT

The T-14 Armata MBT Development Programme was launched in 2011 and pilot tanks was delivered to the Russian Army in 2015. In early 2019, the Russian MoD had announced the beginning of the T-14 Armata MBT field-testing. In 2019 about 16-20 T-14 MBT prototypes have undergone testing with the Russian Army under different climate conditions. According to recent reports the Russian Army slated to receive serial-produced 3rd+ generation 12 T-14 MBTs and four T-16 Armoured Recovery Vehicles, also known as Armata ARV or BREM-T in 2020. In February 2018, the Russian Ministry of Defence (MoD) had signed a contract with Russia's main tank manufacturer Uralvagonzavod (UVZ) for the series production of 132 Armata Universal Combat Platforms including T-14 MBT, T-15 Heavy ACV and T-16 ARV.

Providing the latest rival to the Western world MBTs the T-14 Armata features fully digitized equipment (which requires a high proportion of software and advanced packed battery sets), an unmanned turret (armed with a 125mm 2A82-1M smoothbore gun fed by an automatic loader) and an insulated armoured capsule for the crew. The unmanned turret carries a total of 45 rounds of ammunition, including ready-to-use ammunition. The main gun can also fire laser-guided missiles. The 2A82-1M 125mm main gun can be replaced with a new 2A83 152mm gun in future and a 30mm cannon can be also installed as a secondary gun.

With a combat weight of just 48 tones the T-14 Armata MBT is much lighter than the Western world MBT (e.g. Leopard 2A7, M1A2 Abrams, Leclerc and Challenger 2) and is powered by a 12-cylinder 1,100 kW diesel engine coupled to a 12-speed automatic transmission.

Measuring 10.8m-long, 3.5m-wide and 3.3m-high the T-14 Armata MBT's hull is divided into three compartments, a crew cab at forward, an unmanned remote-controlled turret in the centre and a power-pack at the rear. The driver sits in the left, gunner in the middle and commander in the right inside a special armoured capsule. Entry and exit are provided through three hatches in front of the hull.

Representing a market change in Russian MBT design the T-14 Armata MBT offers much-better crew survivability than any previous Russian or Soviet MBT and compared to previous Russian MBTs which have relatively simple design, fitted with a number of very advanced features some of which have ever been implemented in an operational MBT even in the Western world. The T-14 Armata MBT is equipped with passive laminated armour combined with fourth generation Malachit ERA and the Afghanit hard-kill APS. The Russian news agency Tass has reported that the T-14 Armata MBT will be fully protected not only against ATGMs but also against up to 150mm tank rounds. Since tank is fitted with an unmanned turret the crew has to entirely rely on their sensors for situational awareness and targeting. According to sources the T-14 Armata MBT will be integrated with advanced sensors backed by state-of-the-art battery sets to allow built in situational awareness system to observe, detect and react against incoming threats even the main engine is off.

Meanwhile, citing Russian Minister of Industry and Trade Denis MANTUROV, TASS news agency reported on April 19, 2020 that Russia has tested its T-14 Armata MBTs in Syria. The new T-14 Armata MBT, based on the Armata Universal Combat Platform, is the first serial-produced next-generation MBT ■

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SOM-J

SOM

# New Generation Cruise Missiles SOM Product Family

Work on the serial production and development of different versions of the Stand-Off Missile (SOM), which has been developed as an air-to-ground/surface cruise missile to meet the requirements of the Turkish Armed Forces and those of friendly and allied nations, continues at full speed. The current members of the SOM product family are the SOM-A, SOM-B1 and SOM-B2 versions for use against ground targets, and the SOM-J version for use against naval targets. SOM-A and SOM-B1 feature a high explosive blast fragmentation warhead; SOM-B2 has a tandem penetrator warhead; and SOM-J has a semi-armor piercing warhead. The missile can select between missions based on pre-flight programming and it is possible to select the parameters used to hit the target.

The SOM product family, developed based on the most recent doctrines and technologies related to cruise missiles, stands out with its modular design, which supports the required operational flexibility for use against ground and naval targets with active protection.

The missile family is drawing attention by being lower in weight than its peers around the world and is becoming a center of attention at many international fairs. SOM has a range of 250+ kilometers compared to SOM-J's 185+ kilometers. The missile is equipped with a new generation navigation system, and efforts are underway to transform it into a system that can be reprogrammed mid-flight by means of a data link and used in network centric warfare.

Roketsan conducted the first test firing of the SOM missile in 2011 and launched its serial production in 2013, which is continuing within the scope of the ongoing contracts. The most recent contract related to serial production was signed between the Presidency of Defence Industries (SSB) and Roketsan in 2018, while

negotiations are underway for the production of missiles in accordance with the President's Second 100-day Action Program, made public in 2018.

The Defence Industry Executive Committee, decided in 2012 to launch the local development of precision-guided smart missiles, based on SOM, compatible with the F-35 Joint Strike Fighter (JSF) and the SSB subsequently appointed Roketsan as the contractor for the project, signing a contract in 2014. That same year, a cooperation agreement for the design, development, manufacture and marketing of JSF-Compatible Stand-Off Missile (SOM-J) was concluded with Lockheed Martin Missiles and Fire Control, followed by a contract signed in 2016. The F-35 integration is being carried out in collaboration with Lockheed Martin Aeronautics.

Roketsan points out that the SOM product family will be making its mark in the coming period. "Our SOM product family is growing with members that will meet different requirements. High performance and cutting-edge technology continue to be the common hallmark of the family members, despite being designed for different missions. We believe that SOM, a solution that combines technology, performance and cost in a very balanced fashion, will gain popularity in the global markets in the future and we are continuing our development and promotional activities in that direction."

| | SOM-A | SOM-B1 | SOM-B2 |
|---|---|---|---|
| Length | ~4m | ~4m | ~4m |
| Weight | ~600kg | ~600kg | ~600kg |
| Range | 250+km | 250+km | 250+km |
| Warhead Types | High Explosive Blast/ Fragmentation | High Explosive Blast/ Fragmentation | Tandem Penetrator |
| Warhead Weight | ~250kg | ~250kg | ~250kg |
| Seeker | - | IIR* | IIR* |
| Guidance | INS*/GPS*/TRN* | INS/GPS/TRN/ IBN*/ATA* | INS/GPS/TRN/ IBN*/ATA* |
| Platforms | F-4 F-16 | F-4 F-16 | F-4 F-16 |

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| SOM-J | |
|---|---|
| Length | ~4m |
| Weight | ~500 kg |
| Range | 150+ nm |
| Warhead Types | Fragmentation Armor Piercing |
| Warhead Weight | ~140 kg |
| Seeker | IIR |
| Guidance | INS/GPS/TRN/IBN /ATA |
| Platforms | F-35 F-16 |
| Speed | High Subsonic |

# Meteksan Defence Prevents Jamming Threats Against the Global Positioning Systems with its Innovative Product “Anti-Jamming GNSS”

**Meteksan Defence, who has developed and introduced the high-tech critical systems of the platforms in the defense industry, now offers the users a new product that will prevent the jamming of the Global Navigation Satellite System signals, which is one of the most important threats in the operational environment.**


According to company the Anti-Jamming GNSS Antenna & GPS Receiver also incorporates an Anti-Spoofing capability. The Turkish Armed Forces (TAF) have reportedly experienced GPS Jamming and GPS Spoofing activities during operations in Northern Syria and Libya. In response to such threats Turkish Armed Forces have started to add anti-jam equipment/capabilities to the platforms and weapon systems in its service.

Since the Global Navigation Satellite System (GNSS) signals go a long way until they reach the receiver, they are weakening in terms of power due to atmospheric effects. This situation causes the Global Navigation Satellite System signals to be easily suppressed by various jammers, the receiver to lose the signal tracking and start not producing solutions. The jamming of the Global Navigation Satellite System, which are available on many of platforms, by enemy elements causes great problems including the platforms losing their function or even crash.

It is critical to clear and suppress jammer signals for the survival of our military platforms. In this context, Meteksan Defence has completed the development of the Anti-Jamming GNSS (Anti-Jamming/ Deception GNSS System) product that supports GPS, GLONASS, GALILEO, BEIDOU satellite signals and can work on multiple frequency bands. Thanks to the Meteksan Defence Anti-Jamming GNSS product, direction of the jamming signal can be determined, and suppression of the jamming signals is achieved by using spatial filtering. Jamming signals are filtered by using signal processing techniques, and the original signal without the jamming signal is reconstructed again for delivering to standard GNSS receivers.

Meteksan Defence Anti-Jam GNSS also includes a built-in GNSS receiver capable of decoding GPS satellite signals for calculating position, velocity and time information. This way, without needing an external GNSS receiver, Meteksan Defence Anti-Jam GNSS can both output filtered GNSS RF signal and calculate position/velocity/time information from the filtered signal. Thanks to the high-tech antenna design infrastructure owned by Meteksan Defence, it also develops their own CRPA antenna designs and offers a variety of antenna specific to the platforms.

The Anti-Jamming GNSS, which has been developed by Meteksan Defence, stands out from its counterparts as a product that contains world-class technologies against jamming threats that we may encounter in the combat environment, which can be used on all types of platforms, primarily missile systems and Unmanned Aerial Vehicles thanks to its dimensions and lightness.

Meteksan Defence President Selçuk ALPARSLAN states that the Anti-Jamming GNSS is one of the examples of Meteksan Defence's proactive product development approach: “The high-tech electronic systems we have developed for our many military platforms such as helicopters, unmanned aerial vehicles, missile systems have created a very serious accumulation in terms of human resources, technology, infrastructure and business ecosystem at Meteksan Defence. We transfer this accumulation to other areas that we consider required, without waiting for it to be a project, using our own resources. The Anti-Jamming GNSS is also a product of this approach. We are confident that this new system will make an important contribution to the reliability and security of the platforms of our Turkish Armed Forces.”

Technical Specifications of the Anti-Jamming GNSS:

- Ability to work on GPS L1, GPS L2 and GLONASS L1 frequency bands
- 4 array antenna (CRPA)
- Platform-specific antenna design
- Resistance against more than one jammer signals
- Ability to work at high speed, dynamic and high altitudes
- Low power consumption, lightweight and compact
- Built-in Receiver
- MIL-STD-810G and MIL-STD-461F compliant

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# ERCİYES Project Continues to Move Forward Albeit with Delays!

**by İbrahim SÜNNETÇİ**

News published by Anadolu Agency (AA) on April 28, 2020, shared information and images related to the activities carried out within the scope of the ERCİYES Avionics Modernization Project Serial Production Phase, performed by Turkish engineers and technicians at the 2nd Air Maintenance Factory Directorate (HBFM) in Kayseri. The images featured the modernization activities conducted on C-130 Hercules Military Transport Aircraft, with the tail numbers 608, 609 and 991, painted in Turkish Stars colors.

In his statement to the AA correspondent, the 2nd HBFM Factory Level Maintenance and Repair Manager Aeronautical Engineer Lt. Col. Süleyman ERBİL noted that the maintenance of the C-130B/E Hercules Aircraft is carried out every 6 years at the 2nd HBFM facilities, and the maintenance activities that are completed in 120 working days under normal conditions can take 6 months to 1 year, depending on the aircraft's condition.

The first aircraft (C-130E with the tail number 63-13188), the maintenance of which was completed within the scope of ERCİYES Project (Avionic Modernization of C-130E/B Aircraft) under the coordination of the Presidency of Defense Industries (SSB) and under the main contractor ship of Turkish Aerospace (TUSAŞ), was delivered to the Turkish Air Force Command (HvKK) at a ceremony held at TUSAŞ facilities on August 8, 2014. Speaking at the ceremony, President of Defense Industries Prof. İsmail DEMİR stated that they aimed to complete all modernization activities within the scope of the Project in 2016 and take 19 aircraft into inventory.

The acceptance process of the second and last prototype aircraft of the Project (C-130B with the tail number 61-2634) took longer than planned, and after obtaining flight approval, it was handed over to the HvKK with an acceptance flight conducted in Kayseri in the second half of December 2016. Thus, the Prototype Phase could be completed at the end of 2016 under the ERCİYES Project, the contract of which came into force on January 4, 2007.

The aircraft, which are planned to remain in the inventory until 2040, have been named as C-130BM and C-130EM after the modernization activities.

Within the scope of the Serial Production Phase, five aircraft were planned to be put into service in 2015, and then updated as 2016 and 2017. The 736, 960 and 468 were the three of these aircraft. The work on the first Serial Production Aircraft (Serial No-I, C-130B Aircraft with tail number 58-0736) conducted at TUSAŞ facilities was expected to be completed in 2014 and it was planned to be delivered to the HvKK by the end of the year. However, the acceptance date was later updated as November/December 2015 and then as 2017 Q1. The modernization of the Serial No-I aircraft with the tail number 736 was completed, but as the time for Factory Level Maintenance and Repair activities got closer, it was accepted to conduct such activities and its official delivery to the HvKK was delayed. The delivery date of the Serial No-II aircraft with the tail number 960 (61-960 C-130B) was also planned as 2017 Q1, but the acceptance process was eventually completed on 28 December 2017.

With the revision made in the project schedule, each C-130 Hercules Aircraft to be modernized starting from the 2nd Serial Production Aircraft (4th aircraft modernized in the Project) is subjected to Factory Level Maintenance and Repair activities and then delivered to the HvKK.

The avionic modernization kit integration and

installation activities for each C-130 aircraft take about 6 months, while Factory Level Maintenance and Repair activities take an average of 6-7 months. Thus, the aircraft undergoing maintenance are simultaneously subjected to both Factory Level Maintenance and Repair activities and avionic modernization.

The delay in the project schedule led to a loss of around US$ 25-26 million by TUSAŞ as of October 2015. Additionally, the transformation (workmanship) of two C-130B/E aircraft into C-130BM/EM configuration free of charge in return for the penalty caused by the delay came to the agenda and an agreement was reached with the HvKK. Furthermore, it was announced in those days that TUSAŞ would perform the integration and installation activities of avionic modernization kits for an additional C-130 Aircraft free of charge. Thus, a total of five C-130B/E aircraft, two of which are prototypes, would be modernized and upgraded to C-130BM/EM configuration at TUSAŞ facilities, and, upon the request of the HvKK, the avionic kit integration and installation activities could be performed for an additional six aircraft provided that the costs of workmanship are paid for by the HyKK.

The C-130BM/EM Hercules Military Transport Aircraft is equipped with a Digital Cockpit (4-color Multifunctional Display with a moving map capability), two Central Display Units (CDU) and two multifunction Central Control Computers compatible with international navigational requirements, as well as with a multifunction Mission Computer with high operational capability, Flight Management System (FMS), Ground Mission Planning Unit compatible with the Air Force Information System, and display and lighting systems compatible with Night Vision Goggles.

*The Modernized Cockpit of Turkish Air Forces C-130 Hercules*

The Operational Flight Program (OFP, nearly 3.2 million lines of code) used in the national mission computer (Central Control Computer) to control and manage the new avionic equipment in the aircraft was developed by TUSAŞ engineers in accordance with the DO-178B Level-A standard.

Thanks to the digital cockpit compatible with the Night Vision Goggles (NVG), safe navigation capability has been secured at night, day and under any weather conditions. In addition, the aircraft has gained the capability allowing night jumping (both parachutists and loads) at low altitudes.

Within the scope of the project, the aircraft are also equipped with the MIDS Terminal and Link-16 Tactical Data Link System. Thus, the C-130BM/EM Aircraft become capable of conducting integrated operations with the E-7T Airborne Early Warning and Control Aircraft, modernized F-16s and command control elements (this capability was used in the operation conducted in Libya recently). With the Link-16 Tactical Data Link Integration activities, the aircraft have gained interoperability with other platforms in the inventory (ability to share video, audio and text (in short message format) with other friendly and allied elements). On account of Link-16, C-130BM/EM Aircraft are able to transmit short, concise and cosmic level of confidential information to both ground (air-to-ground) and air (air-to-air) elements.

*The outdated Cockpit of C-130 Hercules in advance of retrofit activities*

The C-130 Hercules Aircraft has a crew of five; two Pilots, Navigator, Flight Engineer and Loadmaster. Thanks to the FMS software developed by TUSAŞ engineers and replacing the Navigator within the scope of the ERCİYES Project, the number of crew in the modernized C-130BM/EM Hercules Aircraft has been reduced to four.

Additionally, in 2013, within the scope of the ERCİYES Project, the transformation of two C-130BM/EM aircraft into the Gun Ship configuration with a new amendment to the ERCİYES Contract was brought to the agenda, but no progress was achieved in the following years

# Turkish Aerospace Team up with HAVELSAN for the T/FX Project


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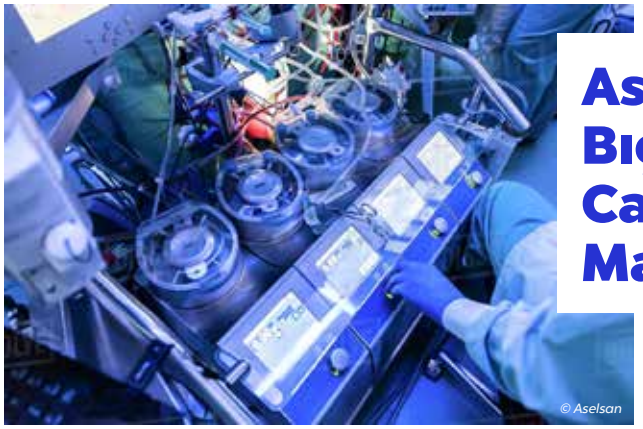
President of Defense Industries Prof.Ismail DEMIR announced that a cooperation agreement was signed between HAVELSAN and Turkish Aerospace (TUSAS), which has been carrying out the development and production processes for the National Combat Aircraft (MMU/T-FX).

Stating that the defense industry has implemented measures at the highest level and has been continuing its activities during the fight against Covid-19, President Prof. DEMIR said that the MMU development activities have also been carried out without any pause. Prof.DEMIR: "With this cooperation, TUSAS and HAVELSAN will be carrying out various activities such as software development, simulation, training and maintenance simulators. Upon the completion of the National Combat Aircraft Development Project, our country will be amongst the countries in the world capable of producing 5th generation combat aircraft with its infrastructure and technology, after the U.S., Russia and China."

The cooperation agreement signed between TUSAS and HAVELSAN involves various activities such as Embedded Training, Training and Maintenance Simulators and engineering support (Virtual Test Environment, project-level software development and cyber security).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# Aselsan and Bıçakçılar to Develop Cardiopulmonary Bypass Machine

May 5, 2020, Aselsan and Bıçakcılar have signed a partnership agreement to nationally develop a cardiopulmonary bypass machine utilized in open-heart surgeries.

Within the framework of this strategic cooperation on the production of a very critical machine that takes over the function of the heart and lungs in open heart surgeries, Aselsan and Bıçakçılar (Turkey's biggest medical device manufacturer with more than 60 years of knowhow in production and commercialization) aim to reverse the import-export balance and to render the state-of-the-art healthcare services accessible through localization.

"We believe that our new product, which is to be developed with Bıçakcılar's knowhow and expertise in the medical device field and with our engineering capacity, will create real value for human life", said İbrahim BEKAR, Aselsan Transportation, Security, Energy, Automation and Health Systems Vice President.

"Cardiovascular Surgery is one of our areas of expertise and combining our expertise with Aselsan's impeccable engineering capacity will lead not only to the production of a state-of-the-art device but also providing access to solutions for cardiovascular surgery in the medical device market", said Bıçakcılar Medical Devices CEO Dr. Souheil El HAKIM.

The technical details of the machine have been determined during the design phase carried out by the R&D teams of the two organizations. With the new product, meeting the needs of the domestic market is the primary objective, then in the next stage the product is planned to be sold throughout the world.

# CES Wins A Significant Contract from A Leading NATO Country


One of the major composite component providers of the Turkish defense industry, CES Advanced Composites and Defense Technologies, has recently been awarded a significant contract to manufacture a full suite of aerospace certified cockpit floors, cabin floors, and wing armor systems for a leading NATO Country. Having been certified to the AS9100 standard – the international standard for the aviation industry – CES is today a reliable solution partner for leading OEM, MRO, and end-users of the aerospace industry for more than ten years.

CES designs and produces innovative and reliable components for the defense and aviation industry, as well as providing light-weight armor and survivability solutions for vehicle and personal protection. Thanks to its infrastructure, capability, and capacity, the company positioned itself as one of the leading suppliers of advanced composite materials, ballistic protective armor, engineering services, and tooling equipment in the local market and targeted global composites and the defense market.

Offering a wide range of products for a broad spectrum of applications, CES's ballistic armor product portfolio includes helmets, vests, inserts, shields, EOD Search Suits, Add-on Armors, and Spall Liners.

CES is the only company in Turkey that develops modular ballistic floor panels, armored wing panels, and pilot seat armor for air platforms. With its engineering power, CES has become the only local supplier for land vehicle platforms for add-on armor solutions and spall liners in Turkey.


© CES

# MÜREN PREVEZE Sonar Subsystem First Stage of Factory Acceptance Tests Initiated

April 13, 2020. According to the Meteksan Defence e-newsletter, an important development was shared for the first time regarding the MÜREN Underwater Combat Management System (CMS) to be used in PREVEZE Class Submarines in the inventory of the Turkish Naval Forces. In the newsletter, it was stated that the latest development was that the 1st Stage Factory Acceptance Tests were initiated on March 2nd, 2020, also with the participation of TÜBİTAK BİLGEM within the scope of the MÜREN PREVEZE Sonar Subsystem Project.

MUREN CMS which is to be used in PREVEZE Class Submarines in the inventory of the Naval Forces Command is being developed by TÜBİTAK BİLGEM (Informatics and Information Security Research Center). The "Procurement Contract of the Sonar Subsystem for the Indigenously Produced Integrated Underwater Combat Management System PREVEZE Class Application" regarding the national development and production of signal processing hardware and software for the sonar and underwater acoustic systems that form the critical component of MÜREN CMS, as well as the integration to the MÜREN CMS was signed between TÜBİTAK BİLGEM and Meteksan on July 31, 2018. With the nationally developed electronic hardware and software within the scope of the contract, together with the MÜREN CMS to be developed by TÜBİTAK BİLGEM, the objective is to eliminate foreign dependency for the sonar, underwater acoustic system and Integrated Underwater Combat Management Systems of the PREVEZE Class submarines, which are an important part of the combat underwater elements of the Turkish Naval Forces. With the efforts to be performed within the scope of the project, prompt, effective and national service support will be achieved in addition to indigenization.

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# SSB to Announce Request for Proposal for Heavy Class Unmanned Ground Vehicles In 2020

In the 5th issue of Havelsan Magazine published on April 27, 2020 Mustafa ŞEKER, the Vice-President of the SSB, stated that under the coordination of the SSB, the work on converting manned armored vehicles into unmanned platforms are still continuing within the scope of Heavy Class Unmanned Ground Vehicles program.

April 29, 2020, in his statement, ŞEKER shared information about the road map of the Presidency of Defense Industries on developing unmanned ground vehicles and the current status of the ongoing projects and said "In this context, the opportunities and capabilities available in our Defense Industries are identified, and the needs are assessed in continuous coordination with users. For this purpose, in 2020 we plan to announce the Request for Proposal (RFP) for the supply of vehicles of middle class equipped with automation kits (making vehicles autonomous) and with the capability of autonomy to an extent identified. Furthermore, there are ongoing efforts to develop an original heavy class unmanned ground vehicle that has high performance in shooting and maneuverability and can perform remote-controlled/autonomously under any weather or zone conditions."

Speaking at the Unmanned and Smart Systems Workshop organized by the SSB in December 2017, a BMC official made a presentation on converting the New Generation Kirpi-2 Mine-Resistant Ambush Protected (MRAP) vehicles into unmanned platforms and shared that they are still working on developing a system that will allow remote control of the unmanned (optionally manned) vehicles to be delivered under the program with the Tactical Vehicle Command Kit developed by Aselsan. If required, the vehicles can be controlled through the portable command unit in another vehicle. It was also shared that the Tactical Vehicle Command kit has a minimum range of 500m line-of-sight (LOS) communication and can display, record, and transfer images through the two driving cameras on the vehicle. Moreover, the images coming from the cameras can be transferred to the portable command unit in one piece or by dividing it into four separate parts. A total of 2 units are planned to be delivered, and thanks to the robot arm attached to the front side of the unmanned Kirpi-2 vehicles, it will be possible to detect and disarm mines and improvised explosive devices (IEDs) from a safe distance.


The Unmanned Ground Vehicles project is being carried out by the Presidency of Defense Industries (SSB) as part of the Presidential 100-day action plan. The project has three main categories: light, medium, and heavy class, and according to the images shared by the SSB, the heavy class vehicles include BMC Kirpi and Amazon Armored Vehicles and Nurol's Ejder YALÇIN Tactical Wheeled Armored Vehicles.

The Heavy Class Unmanned Ground Vehicles are planned to be used in logistics, reconnaissance, and transportation in risky areas. The vehicles can also be employed to engage and neutralize hostile threats when necessary with their high firepower and mobility capabilities. As part of the project, the vehicles are intended to maintain their mobility even after the UGV kit integration. The vehicles, which can also be used as manned platforms when needed (optionally manned), can operate in semi-autonomous mode or can be controlled remotely. The vehicles will also have the capability to record images from at least two driving cameras and transfer them to the Remote-Control Computer or share them with other platforms. Additionally, it will also be possible to control the systems and critical subsystems on the vehicles through the Remote-Control Computer.

# "Local and Unique" Test Kits and Devices being Developed for COVID-19 Capable of Performing Molecular Tests in Under 60 Minutes

**With high sensitivity molecular test kits (LAMP4U) developed with local and national resources, the diagnosis of COVID-19 will be made rapidly and also in the field. The system will use the sample taken directly from the patient and will be able to record the test result instantly via mobile phones.**

April 19, 2020. Supported by the Presidency of Defense Industries (SSB) as a Technology Acquisition Project, BIOSENS - Development of Biological Warfare Agent Detection and Identification System - was developed by NANOBIZ, which is an ODTU Teknokent company. NANOBIZ continues its efforts in the diagnosis of the COVID-19 virus nationally and locally through this system.

As a consequence of the R&D studies that had been carried out by NANOBIZ since April 2017, the BIOSENS platform was developed, which comes in the form of a portable bag-sized laboratory. The system has become capable of detecting ELISA and PCR reactions simultaneously and also in the field.

After COVID-19 cases were reported in our country and as per the call of the President of Defense Industries, Prof. Ismail DEMIR, to the defense industry, defense industry companies revved up their efforts to contribute to the health sector.

The NANOBIZ R&D Team, led by Prof. Hüseyin Avni ÖKTEM, Faculty Member of ODTU Department of Biological Sciences, has accelerated the adaptation activities for the BIOSENS System which was originally developed for use primarily in the defense industry, to become capable of performing molecular diagnosis of COVID-19 with a high degree of accuracy.

By using the BIOSENS system, LAMP4U COVID-19 molecular diagnostic kits developed within this scope were observed to provide high accuracy results in 60 minutes through samples taken from the patients, without the need of a lengthy sample preparation process. It is considered that the BOISENS System will provide a cost advantage as a local and national solution thanks to its ability to perform the tests in the field, to provide rapid results in approximately 60 minutes by reducing the PCR test process (which normally takes 3-4 hours including the sample preparation process) and it is easy-use after short user training.

President of Defense Industries Prof. Ismail DEMIR said the following in his statement on the subject: "In order to utilize our experience in the defense industry in the healthcare field and to realize the national technology move also in this field, we continue our efforts together with our companies under the coordination of our Presidency. We expect the BIOSENS system, which provides fruitful results in the laboratory environment, to go into mass production in a short time after its test process of application in the field. I believe that the BIOSENS system will provide great convenience for our healthcare professionals in the diagnosis of COVID-19. I congratulate NANOBIZ that has developed this system with local and national resources."

# Export from Aselsan to a NATO Country

Aselsan has signed a sales contract with a NATO member country for its remote controlled weapon systems and gunshot detection systems. With this new export contract, the number of countries to which remote controlled weapon systems designed and manufactured by Aselsan have been sold has reached 20.

So far, Aselsan has successfully manufactured and delivered over 3,000 remote controlled weapon systems all over the world.

# STM Announces New Cyber Threat Status Report

Coronavirus triggers cyber-attacks

STM (Savunma Teknolojileri Mühendislik ve Ticaret A.Ş.) released the January-March 2020 Cyber Threat Status Report prepared by STM's Technological Think-Tank Center "ThinkTech", one of Turkey's leading institutions in the field of cyber security and big data. The report pointed out that the fear and sensitivity that societies are experiencing due to the Coronavirus outbreak is being used maliciously by attackers. The report also includes eye-opening analysis regarding cyber threats in digital banking applications, phishing activities targeting citizens, and new types of attack techniques that impact safe driving.

In the new STM ThinkTech Cyber Threat Status Report 'COVID-19 pandemic and cyber-attacks' are analyzed under a separate heading. According to the report, the COVID-19 outbreak has paved the way for many cyber-attacks that exploit the general public who seek out information in this time of unprecedented uncertainty worldwide.

Today, aside from the Coronavirus maps published by the World Health Organization and many other institutions regarding the number of cases and the course of the outbreak, some counterfeit apps are detected that deceive users under the name of real-time Coronavirus maps loaded with malicious software. With the cyber-attacks that occur by installing these fake apps, personal data of many users are accessed. Similar cyber-attacks are also observed on mobile platforms, aimed at accessing photos, videos, cameras and microphones.

## Beware of Social Media Scams!

The report also tackles the attackers that target Turkish citizens under the guise of referring to themselves as the 'Presidency's Communication Center-CIMER Announcement Group' as well as their activities. It is emphasized that the cyber attackers organized on social media plan to capture credit cardholder information by "skimming" attacks through offers of online purchases.

## Targeting Online Banking!

The convenience of online banking and mobile bank apps is preferred by many people today. This enormous market also whets the appetite of cyber attackers. STM ThinkTech's report touches upon the vulnerabilities that place end users' personal information and financial assets at risk, revealing that current developers of Android-based mobile banking and other mobile apps remain insufficient against vulnerabilities on their own. The report emphasizes that end users should not have applications that lack user authentication on their devices, and that banking apps should be kept up to date.

## Cyber Attackers Threaten Safe Driving

Phantom cyber-attacks on electronic systems designed to support safer driving are on the rise and this directly affects human life. STM's latest report underlines that the activation of communication between the electronic systems of semi-autonomous or autonomous vehicles and road-side units leads to vulnerabilities. Amongst the most striking cyber threats are fake lane attacks that negatively affect safe driving, the wrong speed limit reflected to an area that the vehicle can spot by using a drone equipped with projection capability, or attacks that can be made by a misleading speed limit via a captured internet-connected digital billboard.

# New Sale from Aselsan to the Kingdom of Bahrain

Aselsan has signed a new sales contract for the export of remote-controlled weapons systems to the Kingdom of Bahrain for naval use.

May 6, 2020. Maintaining its record performance in sales and manufacturing achieved in 2019 also in 2020, Aselsan signed a sales contract for remote controlled weapon systems and gunshot detection systems for the use of a NATO member country on April 10th. It also announced on April 20th that it signed a new sales contract for the SARP-DUAL Remote-Controlled Weapon System within the scope of the needs of the Kazakhstan Armed Forces.

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# Boeing Rolls Out First Loyal Wingman Unmanned Aircraft

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SYDNEY, May 5, 2020, A Boeing ed Australian industry team has presented the first unmanned Loyal Wingman aircraft to the Royal Australian Air Force, a historic milestone for the company and the Commonwealth.

The aircraft, which uses artificial intelligence to extend the capabilities of manned and unmanned platforms, is the first to be designed, engineered and manufactured in Australia in more than 50 years. It is Boeing's largest investment in an unmanned aircraft outside of the United States.

As the first of three prototypes for Australia's Loyal Wingman Advanced Development Program, the aircraft also serves as the foundation for the Boeing Airpower Teaming System (ATS) being developed for the global defense market.

"This is a truly historic moment for our country and for Australian defense innovation," said the Hon. Scott Morrison MP, Prime Minister of Australia. "The Loyal Wingman will be pivotal to exploring the critical capabilities our Air Force needs to protect our nation and its allies into the future."

Air Marshal Mel Hupfeld, Chief of the Royal Australian Air Force, said the rollout of the first aircraft was a significant milestone in the Boeing Loyal Wingman project.

"This project is an excellent example of innovation through collaboration and what can be achieved working together with defense industry," said Air Marshal Hupfeld. "This demonstrates the importance of the relationship Air Force has with Boeing Australia and defence industry more broadly. I look forward to exploring the capabilities this aircraft may bring to our existing fleet in the future."

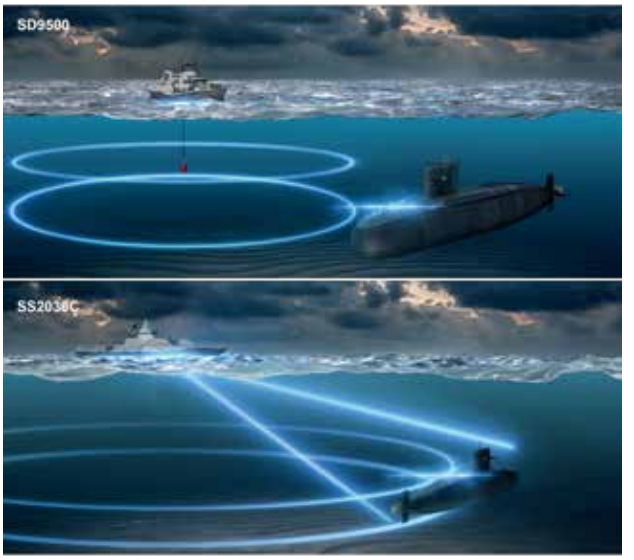
More than 35 members of Australian industry are supporting prototype work across four Australian states. With a global market demand for highly capable but extremely affordable unmanned aircraft, Boeing applied company-wide innovation to achieve those goals. The aircraft was engineered using a digital twin to model its structures, systems, capabilities and full life-cycle requirements; manufactured with Boeing's largest-ever resin-infused single composite piece; and assembled using proven advanced manufacturing processes.


© Boeing

"We are proud to take this significant step forward with the Royal Australian Air Force and show the potential for smart unmanned teaming to serve as a force multiplier," said Kristin Robertson, vice president and general manager of Autonomous Systems for Boeing Defense, Space & Security. "We look forward to getting the aircraft into flight testing and proving out the unmanned teaming concept. We see global allies with those same mission needs, which is why this program is so important to advancing the development of the Boeing Airpower Teaming System."

The Loyal Wingman prototype now moves into ground testing, followed by taxi and first flight later this year.

# KONGSBERG to Supply Finnish Navy Corvettes with Anti-Submarine Warfare and Diver Detection Sonars




April 15, 2020, Kongsberg Maritime AS, Sensor & Robotics is celebrating the signing of a contract with Saab that will see KONGSBERG delivering its market-leading Anti-Submarine Warfare (ASW) and diver detection sonars for the Pohjanmaa-class corvettes currently being developed by the Finnish Navy under its Squadron 2020 project.

Under the terms of the contract, which equates to approximately 100MNOK, KONGSBERG will equip the vessels with its SS2030 and SD9500 sonars, both of which boast acoustic properties which make them ideally suited for deployment in shallow-water environments.

The SS2030, principally devised for ASW operations and capable of detecting torpedoes or other small objects in the water column, is an active hull-mounted sonar which utilises sophisticated tracking algorithms. Its electronically-stabilised transmitting and receiving beams can be tilted to adjust to challenging sound speed profiles, with its integrated Sound Propagation Model determining the optimal tilt settings and enhancing the Probability of Detection (PoD) ratio. The SS2030 sonars will be delivered to the Finnish Navy complete with hoistable hull units and ice protection to ensure safe and efficient operation in the often harsh conditions of the Baltic Sea.

The SD9500, meanwhile, is a light and compact over-the-side dipping sonar with outstanding horizontal and vertical positioning capabilities for diver detection, ASW duties and volumetric survey assignments in shallow, reverberation-limited waters.

"We are very pleased to have been selected for another sonar program for the Finnish Navy and to further strengthen our position as a principal supplier of shallow-water ASW, diver detection and mine-hunting equipment," says Thomas H Dahle, Director of Sales at KONGSBERG. "The armed forces, as with all defence industries, have to rely upon the most advanced technology available in order to fulfil their responsibilities effectively, and this new naval contract is another resounding testimony to the deep level of trust the KONGSBERG brand has accumulated over our many successful years of trading."

# Saab Delivers the First GlobalEye


Saab delivered the first GlobalEye Swing Role Surveillance System aircraft to the United Arab Emirates on 29 April 2020.

The United Arab Emirates has ordered three GlobalEye aircraft, with the initial contract signed in late 2015. In November 2019 the country also announced its intention to complete a contract amendment for the purchase of an additional two systems.

"The delivery of the first GlobalEye is a major milestone for Saab, but also an important step in the history of airborne early warning and control. We have set a new standard for the market and I am proud to say that we have delivered the most advanced airborne surveillance solution in the world to the United Arab Emirates", says Micael Johansson, President and CEO of Saab.

GlobalEye is Saab's new airborne early warning and control solution. It provides air, maritime and ground surveillance in a single solution. GlobalEye combines Saab's new Erieye Extended Range Radar and a range of additional advanced sensors with the ultra-long range Global 6000 aircraft from Bombardier.


# Huge Sales! U.S. Army Awards $6.07 Billion Contract to Lockheed Martin for PAC-3 MSE

May 01, 2020,The contract calls for the production and delivery of PAC-3 MSE interceptors, launcher modification kits, associated equipment and non-recurring efforts to support the United States and global customers.

"This contract demonstrates our customer's continued confidence in our ability to deliver unmatched Hit-to-Kill technology that defeats the ever-expanding global threats of today and tomorrow," said Scott Arnold, vice president, Integrated Air & Missile Defense at Lockheed Martin Missiles and Fire Control. "PAC-3 MSE is one of the most capable multi-mission interceptors, enabling our customers to defend against advanced tactical ballistic missiles, cruise missiles and aircraft."

To meet customer demand and increase production capacity, Lockheed Martin is currently building an 85,000-square-foot expansion at the Camden, Arkansas, facility where PAC-3 MSE interceptors are assembled. The building is expected to be complete by fourth quarter 2021, with operations beginning in first quarter 2022.

Ten nations – the United States, Qatar, Japan, Romania, Poland, the United Arab Emirates, Sweden, Korea, Bahrain and Germany – have signed agreements to procure PAC-3 MSE interceptors

# Ultra Electronics Installs the First S2150 Hull Mount Sonar on Royal Navy Type 23 Frigate HMS Portland

HMS Portland becomes the first ship to be fitted with Ultra's next generation Hull Mounted Sonar Type 2150 as part of a wider refit to the Royal Navy's frigates.

The sonar has been designed by Ultra Electronics Command & Sonar Systems and will replace the legacy Sonar Type 2050, which has been in Royal Navy service since the 1990s. The new sonar incorporates a state of the art User Interface to improve operator effectiveness and usability. The digital control of the outboard array minimises interference, reduces ships cabling, maximises reliability and extends array maintenance intervals to at least 5 years. The sonar will be fitted to eight of the Royal Navy Type 23 frigates. Ultra has also been awarded the contract to supply this sonar to the first three Royal Navy Type 26 frigates currently under construction.

As part of Ultra's 'Sea Searcher' sonar range, Ultra has also developed two smaller and lighter weight variants of the Type 2150 Hull Mount Sonar for naval vessels up to 1,000 tonnes and 2,000 tonnes respectively.

With state-of-the art in-board processing and innovative user displays, this family of sonar systems provides a potent Anti-Submarine Warfare capability for patrol vessels, frigates and other vessels worldwide.

Mike Williams, Managing Director of Ultra Electronics Command & Sonar Systems commented: "Reaching this significant milestone has been key for Ultra. With a number of significant changes from the Sonar 2050 system it replaces, the project team has designed and developed a system that

simplifies user operability and significantly reduces life cycle costs and in board footprint. They have truly excelled themselves".

# The First Barracuda-class Nuclear Attack Submarine Head out for Sea Trials!

**The sea trials of the Suffren, the first Barracuda-class nuclear attack submarine, have just begun. They will enable the French Defense Procurement Agency (DGA) and the French Navy to test the performances of the submarine at sea before her delivery later this year. A total of six Barracuda-class vessels will be added to the French Navy's fleet by 2030.**

May 01, 2020," The first sea trial of the Suffren is a source of great pride for Naval Group employees and their partners. I am extremely grateful for the efforts of our teams. They made it possible to start these trials while respecting strict compliance with the health and safety measures to protect the crew which is partly constituted of Naval Group members. These trials are additional proof of Naval Group's total commitment to the French Navy, the French defense procurement agency (DGA) as well as to the French Atomic and Alternative Energy Commission (CEA), TechnicAtome and the other industrial actors of the defense sector. Together, we are conducting the sea trials that will lead to the delivery of the Suffren and committed to the production of the other five submarines of the series, which is a major priority for the company", declared Pierre Eric Pommellet, Naval Group's Chairman and CEO.


© DGA

## The first sea trial, an important step for the Barracuda program

This series of sea trials follows the divergence of the nuclear reactor which took place in December 2019 and the dock tests carried out since the launch of the submarine on July 12, 2019. The operations successively took place in assembly hall as well as in the dry and water-filled docks to test equipment and systems, such as the combat system. Trials are conducted by joint teams from Naval Group, TechnicAtome and French authorities. Sea trials constitute a crucial phase of qualification of on-board installations for a nuclear submarine and are aimed to ensure:

- water-tightness in underwater environment and maneuverability,
- performance of the combat system, tactical weapons and all the high-tech equipment which are on board of this new generation of nuclear attack submarine
- the full performance of its operational capacities.

The Suffren is the first of class, intended to replace the generation of Ruby-type SSNs. Naval Group is in charge of the production of this series of submarine -, from the design to the construction of the ship - and of the information systems, the manufacturing of the main components of the nuclear reactors as well as the maintenance of the ships in Toulon.

## Responding to an industrial challenge in the midst of a health crisis

The SSN Suffren sea trials are a priority for the Ministry of Defense. Naval Group deployed a series of measures for the protection of the health and safety of the employees in order to continue the operations during the Covid-19 health crisis. Since March 16 a series of security measures has been implemented – particularly for nuclear security - as part of Naval Group's industrial continuity plan for the Cherbourg site and the Barracuda program. Steps were also taken in conjunction with occupational healthcare authorities to the ensure health and safety of the team. Protocols include, for example, systematic compliance with hygiene and disinfection rules and the mandatory use of masks.

In addition, preventive self-isolation measures and screening tests have been carried out on all industrial, military and state members of the team taking part in the sea trials. Finally, the sea trials protocols were adapted, by reducing by 20% the number of people onboard.

## The Suffren: a technology and capacity leap

The Suffren is one of the world's stealthiest submarines. This discretion, combined with her advanced detection capabilities, guarantees her acoustic superiority.

For the first time, thanks to the Suffren-class submarines, the French Navy will have a deep strike capability with MBDA's naval cruise missiles (NCM). The latest generation of SSNs also allows the discreet deployment of Special Forces underwater, in particular thanks to its "divers hatch" and the optional carrying of a dry deck shelter allowing for the deployment of underwater vehicles.

More discreet, with increased autonomy and better capacities, maneuverable and mobile, the Suffren has the latest generation of systems, including a centralized and more automated driving.

# INTERNATIONAL FUTURE SOLDIER CONFERENCE

## 29-30 SEPTEMBER 2020
Sheraton-Ankara

Within the scope of the planned conference program, panels, presentations, and discussions will be held in the following related technology fields:

- Combat Clothing, Individual Equipment & Balistic Protection
- Weapons, Sensors, Non Lethal Weapons, Ammunition
- Power Solutions
- Soft Target Protection
- Soldier Physical, Mental and Cognitive Performance
- Robotics and Autonomous Systems
- Medical
- C4ISTAR Systems
- Exoskeleton Technology
- CBRN
- Logistics Capability

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