CENJOWS

SEMINAR REPORT

MRSAM INDIA ECO-SYSTEM SUMMIT 2.0

07 MAY 2025

PREPARED BY TEAM CENJOWS

INDEX

EXECUTIVE SUMMARY

- The seminar gained added relevance in the backdrop of Operation Sindoor and the Pahalgam terror attack, underscoring the immediacy of strengthening India's air defence architecture to counter emerging hybrid and asymmetric threats.

- It emphasized the need to develop a multi-tiered, integrated air defence system comprising short, medium, and long range capabilities to effectively respond to evolving aerial and missile threats including missiles.

- The MR-SAM system emerged as a flagship example of successful international collaboration and defence indigenisation, now operational across the Army, Navy, and Air Force.

- Real-world conflict case studies from Ukraine and Israel highlighted the importance of real-time data fusion, flexible command-and-control systems, and rapid adaptation cycles for mission effectiveness.

- Discussions called for a shift from siloed service doctrines to joint operations, shared infrastructure, and integrated battle management systems, paving the way for tri-service synergy.

- The defence industrial base in India has significantly matured, with more than 50% indigenous workshare in critical systems, supported by strong MSME participation and public-private collaboration.

- Technological innovations such as simulation based testing, predictive maintenance, and AI-enabled diagnostic platforms were presented as essential to sustaining long-term operational readiness.

- The private sector stressed the adoption of modular designs, resilient supply chains, and proactive obsolescence management to maintain combat readiness and reduce foreign dependence.

- India's liberalised FDI policies, defence corridors, and skilled workforce position it as a key global destination for co-development, strategic manufacturing, and defence exports.

OBJECTIVES

- To bring together key stakeholders from the Indian Armed Forces, defence industry, and international partners to deliberate on evolving air defence needs.

- To review the operational experiences and technological milestones of the MR-SAM system across all the three services.

- To discuss lessons from recent global conflicts and how they can transform India's air defence strategies.

- To explore avenues for strengthening indigenous capabilities and long-term sustainment of advanced missile systems.

- To promote tri-service synergy and industry–military collaboration for future integrated air defence development.

SESSION 1

INAUGURAL SESSION

INAUGURAL ADDRESS BY MAJ GEN (DR) ASHOK KUMAR, VSM (RETD), DG CENJOWS

1. **Introduction**. The inaugural address of the Seminar, jointly hosted by CENJOWS and Aerospace Services India (ASI), an Indian venture and Israel Aerospace Industries (IAI), was delivered by DG CENJOWS. He stressed the significance of the timing of the seminar, coinciding with India's response to the Pahalgam terror attack, underscoring the urgency and relevance of the seminar's core theme: strengthening India's air defence architecture.

2. The inaugural address opened with a strong expression of pride in hosting this landmark event. It highlighted the strategic significance of air defence in modern warfare and recognised the long-standing partnership between India and Israel in advancing technological collaboration, operational readiness, and defence indigenisation.

3. **Key Takeaways/Recommendations.**

- **Relevance of the Seminar in Light of Emerging Threats.** The Pahalgam attack was cited as a stark reminder of the immediacy and reality of threats faced by India. Given India's vast geographical spread, both land-based and maritime, and the collusive threat posed by China and Pakistan, DG CENJOWS emphasised the need for constant readiness and multi-dimensional defence capabilities.

- **Importance of Multi-Tiered Air Defence Systems.** Air defence cannot rely on a single system; it requires an integrated, tiered architecture that includes short-range, medium-range, and long-range Surface-to-Air Missiles (SAMs). Drawing from Israel's experience in defending against complex threats from Hamas, the address noted that Israel's layered and near-impregnable air defence model offers valuable lessons for India.

- **Strategic Insights from the Russia–Ukraine Conflict.** The ongoing Russia-Ukraine war has redefined the battlefield. The proliferation of drones, swarm drones, and cruise missiles have made it clear that air defence must evolve rapidly to remain effective. These developments reinforce the importance of real-time threat identification and interception, especially at medium range.

- **Medium-Range SAMs as an Operational Priority.** While both long-range and short-range SAMs have specific advantages and limitations, the address underscored the strategic value of medium-range SAMs as the most balanced solution for India's operational needs.

- **Indigenisation and Strategic Autonomy.** Emphasising India's growing focus on defence indigenisation, the address highlighted how Israel's support, through partnerships with DRDO, BDL, BHEL, and other Indian entities, is contributing to joint ventures, co-manufacturing, and the creation of a resilient industrial base. Many of these platforms are already being manufactured in India, and more facilities are expected to be established to reduce strategic dependence and enhance supply chain security.

- **Positioning India as a Global Defence Provider.** India is now aligning its defence production strategy to serve both domestic military requirements and friendly foreign nations. The address also highlighted the government's push towards Atmanirbharta (self-reliance) and emphasised the importance of strategic partnerships in achieving this goal.

4. The inaugural address conveyed a clear and urgent message: air defence is no longer optional; it is essential, layered, and strategic. The evolving threat landscape, amplified by recent attacks and global conflicts, requires India to continue investing in indigenised, technologically superior, and operationally agile air defence systems. The speaker reaffirmed the importance of India–Israel defence cooperation and appreciated the presence of key stakeholders and industry partners. As India prepares for future threats across land, air, sea, cyber and space domains, the seminar set the tone for informed dialogue, cross-national collaboration, and actionable defence innovation.

ADDRESS BY H E REUVEN AZAR, AMBASSADOR OF ISRAEL TO INDIA ON THE 'GEOPOLITICS OF THE REGION AND INDO-ISRAEL RELATIONS'

5. **Introduction.** In the face of rising global threats and asymmetric warfare, missile defence has become an indispensable pillar of national security for democratic states. Drawing from the live experiences of countries like Israel and India, the speaker outlined the strategic rationale behind investing in missile defence and the urgent need for international cooperation in combating terrorism. The insights presented reflect a shift from Cold War-era doctrines towards a more adaptable, multipolar security framework. The speaker also emphasised the significance of the India-Israel defence partnership and the lessons learned from operational challenges, including the October 7 attacks on Israel.

6. **Key Takeaways.**

- **The Right to Self-Defence Is Fundamental.** Nations possess an inherent right to self-defence in response to acts of terrorism and large-scale attacks on civilians. Israel's experience affirms that such threats must be met with firm resolve and cannot be justified or contextualised.

- **Terrorism Cannot Be Justified or Normalised.** Terrorism, in all its forms, violates the core principles of humanity and decency. Global consensus is essential to categorically reject and combat such actions.

- **As Democracies Rise, Hostile Forces Intensify Disruption.** As India and Israel grow stronger economically and militarily, adversaries increasingly resort to unlawful and destabilising tactics. This frustration leads to breaches of international norms intended to undermine democratic progress.

- **Historic Scepticism Towards Missile Defence.** During the Cold War, missile defence was criticised for allegedly destabilising the MAD (Mutual Assured Destruction) equilibrium between superpowers. Military and strategic circles feared that it would encourage conflict or diminish the legitimacy of pre-emptive doctrines.

- **Shift Towards Multipolar Security Realities.** The bipolar strategic logic no longer applies in today's multipolar threat environment. Modern missile defence is essential for nations dealing with irregular and state-sponsored threats alike.

- **India–Israel Missile Defence Cooperation as a Strategic Imperative.** Both nations face similar threat environments and have acted early to cooperate on missile defence development. This bilateral partnership highlights the value of aligned democracies working jointly to safeguard shared interests.

- **Operational Validation: Post-October 7 Lessons.** Despite intelligence and operational lapses during the October 7 attack, Israel's sustained investment in missile defence proved effective in minimising damage through responsive countermeasures. Over $10 billion in long-term defence investments paid strategic dividends when it mattered most.

7. **Recommendations**

- **Maintain Long-Term Investment in Missile Defence Infrastructure.** Ensure consistent funding, system modernisation, and operator training to address evolving threats.

- **Deepen India–Israel Strategic Cooperation**. Strengthen bilateral mechanisms for joint development, technology transfer, and operational interoperability in air and missile defence.

- **Reframe Missile Defence in Global Security Discourse.** Advocate internationally for missile defence as a stabilising force in the 21st-century security environment, not as an escalation trigger.

- **Integrate Post-Crisis Learning into Strategic Planning.** Conduct transparent and rigorous reviews after operational failures to validate existing systems and strengthen future readiness.

- **Expand Multilateral Defence Partnerships.** Leverage trilateral or broader coalitions (e.g., with the U.S.) for joint R&D, shared situational awareness, and cross-border missile shield architectures.

8. The speaker threw light on the importance of the partnership between India and Israel, which stands as a powerful example of what strategic cooperation can achieve. Together, through shared technology, common purpose, and mutual trust, both nations are redefining the future of defence preparedness. The lessons of recent history underscore not only the need for vigilance and readiness but also the imperative to stand united in defending the values and sovereignty of democratic nations.

KEYNOTE ADDRESS BY AIR MARSHAL RAKESH SINHA, AVSM, DCIDS (Ops), HQ IDS

9. Due to the commencement of Operation Sindoor during the early morning hours, he could not attend the event physically. Some of the inputs are as under:-

- It is an honour to be part of the MR SAM India ecosystem summit 2.0, a gathering that reflects the convergence of strategic vision, indigenous capability, and international collaboration in strengthening India's defence posture.
- We are navigating an era marked by escalating geopolitical tensions and rapidly evolving threats. From the wars in Ukraine and the Middle East to the exponential rise in drone warfare and precision-guided munitions, the battlefield has fundamentally changed. Closer to home, the recent terrorist attack in Pahalgam and the renewed tensions along our western borders are sobering reminders that India continues to operate in a dynamic and volatile security environment.
- In such scenarios, safeguarding our skies, our strategic assets, and our warfighting formations is not optional; it is imperative. This is where air defence plays an important role as a decisive shield against evolving aerial threats in a complex regional security environment. Among India's foremost achievements in this domain is the medium-range surface-to-air design MR-SAM system, chiefly developed by ERDL and Israel Aerospace Industries and deployed by all three services. MR-SAM stands as an important force multiplier.
- It exemplifies India's commitment to building world-class, indigenously supported air defence capabilities. I take this opportunity to congratulate the Indian Army and the Indian Navy on their recently conducted highly successful operational piloting trials. These were not just technical demonstrations; they were operational milestones reinforcing that MR SAM is far more ready, precise, and supremely reliable in utilising contemporary air area trends.
- This system is not merely a technological platform, it is the outcome of an ecosystem built on collaboration, commitment, and competence. It reflects a collaborative ecosystem, DRDO, IAI, BDL, private industry, and key service partners like Aerospace Services India, all working in unison to deliver a cutting-edge, indigenised defence solution.
- The role of Aerospace Services India, with its focus on indigenous MRO, predictive maintenance through storms, and forward-looking localisation, is truly commendable. Their efforts are ensuring high availability and long-term sustainability of this mission, a critical asset.

- This summit goes beyond being a platform for discussion, it is a launchpad for deeper integration, strengthened joint mission, and forward-looking strategies. I commend Aerospace Services India and all stakeholders for enabling this vital convergence of thought, technology, and capability.
- As we face increasingly agile and asymmetric threats, our response must be multi-layered, integrated, and technologically superior. The MR SAM ecosystem is not just a program, it is a national capability, a strategic shield, and a testament to our preparedness. Let this summit reaffirm our collective resolve to build a secure, self-reliant, and future-ready India.

SPECIAL ADDRESS BY AIR MARSHAL ASHUTOSH DIXIT, PVSM, AVSM, VM, CHIEF OF INTEGRATED DEFENCE STAFF

10. Due to the commencement of Operation Sindoor in the early morning hours, he could not attend the event physically. He, however, shared his message as under:-

- The Indo-Israel defence relationship has evolved into a dynamic and multi-dimensional partnership rooted in shared security concerns, technological collaboration, and mutual trust. This partnership continues to play a vital role in advancing India's defence capabilities, offering pathways for joint development, operational innovation, and strategic convergence.

- Among the many successful outcomes of this collaboration, the Medium Range Surface to Air Missile (MRSAM) programme stands out as a landmark achievement. Designed to counter a wide spectrum of aerial threats, MRSAM represents a confluence of Israeli technological prowess and Indian engineering and operational excellence. Its induction across all three Services is a testament to its effectiveness and relevance to India’s integrated air defence strategy.

- The programme’s impact, however, extends well beyond the missile system. It has fostered a vibrant and resilient ecosystem encompassing research institutions, public and private sector industries, logistics networks, training systems, and user communities. This ecosystem represents a living example of India’s journey towards defence self-reliance through global partnerships and national enterprise.

- The MRSAM India Ecosystem Summit 2.0 is a significant platform to recognise the collective contributions that have enabled this success. It enables stakeholders to engage meaningfully on sustaining, scaling, and replicating such ecosystems for future defence programmes. Most importantly, it reinforces the importance of strategic cooperation as a catalyst for capability development.
- I commend Aerospace Services India and CENJOWS for spearheading this initiative. The Summit will undoubtedly add momentum to India's defence industrial base and further deepen the Indo-Israel defence engagement.

11. **Key Takeaways**

- **Evolution of Indo-Israel Defence Partnership.** The relationship has grown into a dynamic, multi-dimensional partnership centred on shared security concerns, technological collaboration, and mutual trust. This partnership is crucial for advancing India's defence capabilities and strategic innovation.

- **Success of the MR SAM Programme.** The Medium Range Surface to Air Missile (MRSAM) programme stands out as a landmark achievement, combining Israeli technology and Indian engineering. Its induction across all Indian armed forces highlights its operational effectiveness and strategic relevance.

- **Broader Impact Beyond Missile Systems.** The collaboration has fostered a resilient ecosystem involving research institutions, public and private industries, logistics, training systems, and user communities. This ecosystem is a key driver of India's journey towards defence self-reliance.

12. He concluded by stating that the Summit serves as a platform to recognise collective contributions and enable meaningful stakeholder engagement. It emphasises the importance of sustaining, scaling, and replicating such ecosystems for future defence programmes and strategic cooperation.

PRESENTATION BY COL (RESERVIST) CHAIM MORIYA, IDF-IAI, TITLE: THE CONCEPT AND INSIGHT INTO THE AIR DEFENCE OF IDF WITH SPECIFIC REFERENCE TO ONGOING WAR

13. **Introduction**. Colonel (Res) Chaim Moriya of the Israel Defense Forces started with statement that 'Modern warfare has transitioned far beyond simple battlefield engagements'. The very nature of operational coherence today rests on the ability of multiple, often dissimilar, systems to talk to each other meaningfully. The fusion of platforms—whether aerial, terrestrial, or maritime—requires more than just technical compatibility. It demands a foundational trust among systems, operators, and decision-making hierarchies. At the heart of this trust lies a brutally difficult yet essential process: Communication across diverse technological interfaces and hierarchical echelons. Colonel Moriya emphasizes that interoperability is not simply a matter of machine-to-machine protocols but involves a deep-seated understanding of the status, relevance, and credibility of messages exchanged across systems. The nature of the message—its origin, its purpose, and the kind of action it should invoke—is as critical as the message itself.

14. Offering a tangible illustration: when two independent targeting systems observe the same object, but without coordination or data sharing, one may interpret it as a single target while the other sees multiple threats and without synchronization, such misalignments may lead to operational failure or worse fratricide. Building systems that can fuse data and validate one another's inputs takes years of iterative trust-building, software tuning, and operational testing. Cost-efficient optimization of inter-service communication and decision-making is not merely a force multiplier—it is a survival imperative.

15. **Key Takeaways/Recommendations**

- **Human-Machine Teaming and Embedded Operational Feedback.** The Israel's approach which can be emulated by others, is the structural and cultural embedding of human-machine synergy. Colonel Moriya highlights the IDF's unique ecosystem where operational users and engineers often overlap. This dual-hatted identity facilitates a powerful feedback loop: an operator identifies a shortcoming during real-time deployment, and the same individual—now acting in their engineering capacity—modifies the system to correct the flaw. This embedded model allows expediting rapid operational learning cycles. This model underscores a larger philosophical shift: the battlefield is no longer just a domain of destruction, but also of a learning opportunity. Colonel Moriya further expands this point by categorizing

problem-solving timelines. In scenarios where time is at premium, predetermined responses elucidated from pre-set systems are prerequisites. If time lines are stretched, then deployments and reconfigurations are possible. Over days or weeks, entire system architectures, software and hardware, can be recalibrated. This temporal flexibility, built on embedded learning and engineering, gives militaries the advantage of adaptation within operational cycles rather than between them.

- **Lessons from Ukraine: Real-Time Adaptation and Operational Flexibility.** The Russia-Ukraine conflict serves as a laboratory conducting a number of experiments and results of which can be assimilated in modern warfare. Colonel Moriya analysis of the Ukrainian defense reveals the stark contrast between the early days of the war, when Ukraine lacked advanced systems—and the later phases, when it had begun to integrate Western technology and, crucially, develop its own engineering responses. The Ukrainian response evolved from raw resilience to sophisticated countermeasures as their systems, operators, and engineers learned and adapted. Colonel Moriya noted that many of Ukraine's initial attempts to defend using indigenous weapons were only partially effective. Success comes not solely from acquiring new weapons, but from adopting adaptive operational processes. Ukrainian engineers began to adjust existing tools, optimize deployments, and integrate disjointed systems into a functioning Command and Control (C2) architecture. This reinforces Moriya's broader takeaway: the resilience of a military lies not in having the best technology per se, but in cultivating the ability to adapt, modify, and integrate technologies under duress. Systems must not only function independently; they must also be able to cooperate dynamically, share data, and do so in a trusted and validated fashion. Beyond systems and sensors, the human-machine interface remains critical. Proper packaging of systems—intuitive displays, manageable operator workloads, and clear control hierarchies—can determine whether a system amplify or diminishes battlefield performance.

- **Command, Control, and the Evolution of C2 in Israel's Air Defence.** One of the most transformative aspects of the Israel Defense Forces' (IDF) air defence capability is its command and control (C2) philosophy. The centrality of an adaptable, multi-layered C2 infrastructure is the hallmark of IDF's CONOPS. In a threat environment characterized by relentless onslaught of high-velocity projectiles, drones, cruise missiles, and cyber incursions, rigid C2 structures can lead to catastrophic delays or miscalculations. The IDF has addressed this by investing heavily in what might be

described as “cognitive flexibility” within its C2 architecture. At the heart of this adaptability is decentralization—empowering Field Commanders and operational units with real-time data and decision-making authority. Such authority is underpinned not just by trust but by training, data integrity, and rigorous testing. The goal is to allow nodes within the defence grid to act independently when necessary but always with shared situational awareness. This concept of “shared awareness” has been made possible through an ecosystem of connected sensors, radar arrays, and intelligence feeds. In air defence, this is crucial. Furthermore, emphasis on human-in-the-loop oversight ensures that while automation is central, it is never absolute. Operators remain engaged in the process, verifying anomalies, correcting data mismatches, and executing override commands when machine decisions deviate from battlefield realities. This hybrid approach—balancing automation with human oversight—is a hallmark of the IDF’s air defence philosophy. Another notable insight is the concept of “layered defence,” which the IDF has operationalized with systems like Iron Dome, David’s Sling, and Arrow. Each system is designed to intercept a specific range and type of threat, from short-range rockets to long-range ballistic missiles. These systems are integrated through a shared C2 structure, ensuring that resources are used efficiently.

- **Engineering for the Battlefield: Embedded Adaptability and the Role of Industry.** One of the most unique elements of the IDF’s air defence model, as highlighted by Colonel Moriya, is the proximity between users and developers. This coalescing of dual identity between operator and engineer fosters a culture of problem-solving that is immediate, grounded, and field-informed. The benefits of this model are substantial. Problems identified in the field can be directly addressed with suitable engineering modifications. Colonel Moriya also stresses the importance of scenario-based learning and system validation through simulation. Before new software iterations are deployed, they are tested under combat-like conditions using real operational data. This simulation-driven approach enables the IDF to anticipate how systems will respond under stress, allowing developers to refine algorithms before they face real-world threats.
- **Training, Readiness, and Future Trajectories:** A recurring theme in Colonel Moriya’s address is the centrality of continuous training and readiness in ensuring effective air defence. Technology alone does not guarantee success; it is the preparedness of personnel and the institutional ability to learn, adapt, and evolve that determine outcomes. In the IDF, training is treated not as a discrete phase but as an

ongoing cycle that incorporates live data, simulation feedback, and operational lessons learned. Operators are not only trained on how systems function but also on how they fail—what errors to anticipate, how to diagnose them in real-time, and how to recover functionality under stress. This results in a force that is not only technically proficient but mentally conditioned to operate under ambiguity and pressure. Looking ahead, the IDF appears committed to deepening its integration of artificial intelligence, autonomous systems, and advanced analytics into its air defence infrastructure. However, Colonel Moriya's remarks make it clear that Israel's success does not lie solely in high-tech adoption. Rather, it is the integration of human judgment, system design, and responsive engineering that gives Israeli air defence its edge. In an age of complex threats, this human-machine synergy will remain a decisive factor on the modern battlefield.

- **Towards a Culture of Continuous Adaptation:** Colonel Chaim Moriya's insights offer a holistic perspective on what modern warfare demands—not just from systems or strategies, but from the entire military ecosystem. His reflections from the IDF, paired with lessons drawn from the ongoing war in Ukraine, paint a clear picture: success in contemporary conflict is less about possessing the most powerful weapons and more about the integration, adaptability, and agility of the entire defense apparatus. He challenges to think of combat as a dynamic learning process. Every engagement should trigger a reflexive loop: observe, diagnose, modify, and re-apply. This applies at the level of software patches, operator training, C2 architecture updates, and even hardware configurations. The most valuable asset is not a missile or a drone, but a culture that enables operators, engineers, analysts, and commanders to work as one adaptive unit.

- Moreover, trust between systems, between people, and between domains—emerges as a foundational principle. Without trust, systems fail to synchronize, and decisions lose context. Building this trust takes time, patience, and an ongoing commitment to refining communication and interoperability. Inter-service coherence, agile reconfiguration, and human-machine integration are not futuristic ideals—they are urgent necessities. The road to such capabilities can't be paved in one stride, rather it is a continuous journey of learning, integration, and adaptation. That, is the ultimate force multiplier in warfare.

PANEL DISCUSSION 1

AIR DEFENCE DOCTRINE AND PHILOSOPHY-INDIAN ARMED FORCES FEATURING: AIR MARSHAL ANIL CHOPRA, PVSM, AVSM, VM, VSM (RETD), LT GEN A P SINGH (RETD), EX DG AAD AND MAJ GEN ROOPESH MEHTA, SM, VSM, ADG (CD&S)

16. The panel discussion featuring Air Marshal Anil Chopra (Retd), Lt Gen A P Singh (Retd) and Maj Gen Roopesh Mehta underlined India's strategic shift. Along with military and doctrinal shift, this is deeply embedded in a vision for long-term defence-industrial collaboration, technology transfer, and operational self-reliance. At the heart of this evolving ecosystem lies the MRSAM (Medium Range Surface to Air Missile) programme, a product of Indo-Israeli collaboration, which now serves as a model for co-development, indigenous capacity-building, and lifecycle support.

17. **Operational Readiness and the Doctrinal Shift in Air Defence.** Air Marshall Chopra emphasised the criticality of early warning systems, layered defence architectures and integrated Command structures as foundational elements of India's air defence doctrine. The increasing relevance of real-time situational awareness driven by satellite, radar, and electronic intelligence inputs and ability to track and respond to threats before they manifest physically is vital. Lt Gen AP Singh (Retd), drawing from his decades-long experience with the Army's air defence units, highlighted as to how traditional distinctions between air and ground defence responsibilities have blurred. He called for a unified doctrinal philosophy that accommodates Joint operations, Integrated Battle management systems and offensive air defence tactics. The role of the operator was underscored as a critical link in the kill chain. Modern air defence system must be agile, mobile and capable of offensive denial strategies that pre-empt enemy strikes. All speakers stressed on necessity of transitioning from legacy systems towards more versatile and integrated air defence networks. These must cater to complex nature of modern warfare encompassing swarming drone attacks, hypersonic weapons, and electronic warfare.

18. The convergence of operational insights from military leadership and the industrial ecosystem around MRSAM presents several key lessons for India's defence strategy:-

- **Jointness and Interoperability Are Non-Negotiable.** The future conflicts will not be segregated by domain. The imperative is to build platforms and doctrines that function jointly, share data seamlessly, and can operate under integrated command-and-control systems.

- **Operators and Human Capital Matter**. The central role of well-trained personnel in ensuring system efficacy needs no emphasis. From interpreting sensor inputs to executing engagement protocols, the quality of operators determines the success of even the most advanced systems.

- **The Path Ahead: Building a Resilient and Forward-Looking Ecosystem**: Initiatives such as iDEX (Innovations for Defence Excellence) and partnerships with private industry must be linked more directly to frontline projects with clearly defined milestones for integration. Crucially, doctrine must keep pace with technological advancement. As Lt Gen Singh suggested, the army's traditional static air defence posture is no longer viable. Instead, India must prepare for a world where drone swarms, precision-guided munitions, and cyber interference are the first wave of attack. Air defence, therefore, is not only about intercepting missiles — it's about denying the enemy freedom of action across all domains.

- **Institutional Reforms and Positioning India as a Global Defence Partner**: To effectively build upon the gains from programmes like MRSAM, India must reinforce its institutional structures and policy frameworks that govern defence production and operational deployment. While agencies like DRDO, BDL and BEL have served as key anchors, the need for faster decision-making, agile procurement mechanism and flexible joint Command can't be over emphasized. The Services, MoD and industry must put in integrated efforts under a shared vision on threat perception and prioritization, capability envisaged and export potential. The siloed approach — where R&D, acquisition, and operational deployment are often out of sync — must give way to an integrated warfighting and industrial doctrine.

18. A shift toward this unified approach also offers India the opportunity to position itself not just as a defence importer or assembler, but as a reliable, innovative contributor to global supply chains. The trust and interoperability demonstrated in the Indo-Israeli partnership provide a platform to expand such collaborations with other strategic partners, from the US and France to Southeast Asian and African nations looking for affordable and effective air defence solutions. Systems like MRSAM, developed in a collaborative and performance-proven manner, serve as a template for future co-development ventures, especially in areas such as unmanned systems, electronic warfare, and space-based sensors. Moreover, there is an urgent need to institutionalize innovation. Startups, research institutions, and MSMEs that support the defence sector which must be systematically linked to the Services' operational needs and long-term strategic goals. Creating technology demonstration platforms, operational testbeds, and modular upgrade pathways would ensure India is not just reacting to the evolving nature of warfare but proactively shaping it. Ultimately, the strength of India's future air defence capability will not lie in isolated systems, but in the strength of its ecosystems, industrial, doctrinal, human, and technological, built to endure and evolve.

19. India's evolving air defence architecture, as reflected in the MRSAM ecosystem and the doctrinal reflections of senior military leaders, marks a decisive step toward greater strategic self-reliance. The convergence of indigenous capacity-building, collaborative innovation, and joint operations doctrine offers a powerful framework to confront hybrid and conventional threats alike. To sustain this momentum, India must institutionalize what it has learned: integrate forces, invest in people, build resilient ecosystems, and above all, act with the foresight that the next war may not begin with gunfire but with a signal on a screen.

PRESENTATION BY ODED JACOBWITZ, VP & GM AMDS, IAI AND CHAIRMAN ASI
TITLE: MRSAM ECO-SYSTEM

20. The speaker started by invoking audience attention at rethinking of Air Defence in the Age of Hybrid Threats. In the face of evolving security challenges that range from conventional threats to hybrid and grey-zone warfare, the strategic leadership and defence establishments have increasingly focused on integrated, resilient, and technologically advanced air defence capabilities. This need becomes more imperative due to proactive and multi-domain threats posed by adversaries such as China and Pakistan, who are progressively leveraging cyber tools, precision strikes, and disinformation as part of broader hybrid strategies.

21. The MRSAM project, jointly developed by India's Defence Research and Development Organisation (DRDO) and Israel Aerospace Industries (IAI), exemplifies how cross-border collaboration can catalyse indigenous defence capability. The speaker provided a comprehensive overview of the ecosystem that has emerged around MRSAM since its inception in 2006. The core philosophy underpinning the programme is "collaboration as a force multiplier." The project over nearly two decades has transformed into a robust ecosystem involving Indian entities such as Bharat Dynamics Limited (BDL), Bharat Electronics Limited (BEL), and numerous MSMEs across the country. As of 2025, approximately 60% of the MRSAM system is manufactured in India — a figure that continues to grow. This journey reflects not just industrial localization but the internalization of critical skills by Indian partners. Initially reliant on Israeli technical support, Indian technicians now independently manage integration, testing, and servicing of systems with Army, Navy, and Air Force. This shift is emblematic of a maturing defence-industrial base and a model that could be replicated across other strategic programmes.

22. **Key Takeaways/ Recommendations**

- **Lifecycle Support, Indigenous Capacity, and Technology Transfer:** A significant emphasis in Mr Jacobwitz's presentation was on lifecycle support. He argued that building a high-performance system is only half the battle won; maintaining its availability, reliability, and performance over decades is equally crucial. One key takeaway from the MRSAM experience is that technology transfer is not instantaneous. It demands iterative training, infrastructure development, and occasional failures that become learning opportunities. The ability of BDL to conduct full missile integration and testing within one week, once an unimaginable timeline, now demonstrates the operational flexibility achieved.

- **Strategic Autonomy through Collaborative Growth:** The MRSAM programme shows that strategic autonomy need not mean complete isolation. Instead, collaborative platforms, where knowledge is genuinely shared and indigenous capability developed, can offer both resilience and sovereignty.

- **Institutionalise Lifecycle Management:** Defence planning in India must institutionalize lifecycle logistics, spares, and technical support in procurement contracts. A weapon system is only as good as its operational availability, and maintaining readiness over decades requires continuous technical backing.

- **Invest in Infrastructure and Fail-Safe Ecosystems:** As Jacobwitz reiterated, building a defence ecosystem is a long-term process. It involves not just factories but testing labs, design feedback loops, logistics chains, and simulation capabilities. Failures must be seen not as setbacks but as steps in refining capacity.

23. India's goal of becoming a defence manufacturing hub is intricately linked to its ability to develop and sustain complex platforms like MRSAM. The success of this programme offers a blueprint: begin with meaningful partnerships, ensure deep technology absorption, and then invest steadily in expanding domestic capacities. What is clear from both the military and industrial perspectives is that time, trust, and training are indispensable to this process.

SESSION 2

PANEL DISCUSSION 1

LESSONS LEARNT FROM WAR IN ISRAEL AND UKRAINE FROM AIR DEFENCE PERSPECTIVE

FEATURING: MAJ GEN NEERAJ SHUKLA ADG SP, COL (RESERVIST) CHAIM MORIYA, IDF-IAI, MR EYAL ZOHAR- ELTA, IAI, CMDE MANAV SEHGAL, IN AND BRIG M KK IYER (RETD)

24. The session, titled *"*Lessons Learnt From War in Israel and Ukraine from Air Defence Perspective,*"* spanned approximately 40 minutes and featured a dynamic mix of expert presentations and panel discussions. Focusing on recent conflicts such as the Israel-Hamas confrontation and the Russia-Ukraine war, the discourse explored key strategic, technological, and doctrinal takeaways with direct relevance to India's evolving defence posture. Speakers analysed the operational use of advanced missile systems, UAVs, electronic warfare, and integrated command structures, drawing parallels to India's own defence challenges. Emphasis was placed on the critical need for adaptive doctrines, real-time intelligence, and indigenously developed technologies to ensure resilience in both air and maritime domains. The session served as a timely and insightful exploration of how global conflict dynamics can inform and shape India's defence preparedness.

25. **Opening Remarks by the Chairperson.** The session commenced with a thought-provoking address by Maj Gen Neeraj Shukla, ADG SP**,** who emphasised the urgency and complexity of modern warfare. Echoing Dr Purnik's assertion that future weaponry must be lightweight and cost-effective, he underscored that in contemporary conflicts, time is a critical and limited resource. General Shukla reflected on the shifting character of warfare, noting the rise of regional confrontations over traditional state-on-state wars, with the Israel-Hamas and Russia-Ukraine conflicts serving as instructive examples. He spoke with particular appreciation of India's strategic partnership with Israel, describing it as a civilizational relationship that extends beyond transactional defence cooperation. Recalling his personal interactions with General Nimrod Aloni, he shared how those engagements enriched his understanding of modern strategic imperatives. Concluding his remarks, General Shukla highlighted the growing dominance of the aerial domain in warfare, calling for advanced technological integration and multi-platform preparedness to effectively address emerging threats.

26. Following the Chairperson's address, Col Chaim Moriya delivered a detailed analysis on the evolving character of warfare, drawing comparative lessons from the conflicts in Ukraine and Israel. He focused on three critical themes shaping the future of combat operations. First, he noted the marked decline in the use of manned aerial strikes, as modern battlefields increasingly rely on ground-launched precision munitions and unmanned aerial vehicles (UAVs). These systems, requiring fewer personnel and offering a lower logistical burden, are both cost-effective and easily deployable. Second, he addressed the persistent challenge of sensing and detection, particularly in identifying small, slow, low-flying objects such as quadcopters and drones. Highlighting Ukraine's creative use of pole-mounted microphones for drone detection, he suggested such innovations could inform India's own defense adaptations. Lastly, Col Moriya stressed the urgent need for a unified air defense infrastructure, capable of integrating multiple platforms into a centralized command and control system. He warned that without seamless coordination and shared situational awareness, defending wide operational spaces against increasingly frequent and low-cost threats becomes untenable. He concluded with a strong message: future conflicts will be defined by minimal-signature systems and the effectiveness of integrated, real-time air defense networks.

27. The next speaker was Mr Eyal Zohar, a seasoned defence technology expert with over 25 years of experience in innovation and strategic marketing. Drawing on Israel's recent defense engagements, he presented five key insights that emphasized the critical role of technological adaptability in modern warfare. He advocated for future-proof defense systems designed with modularity and software-driven upgrades, comparing them to Tesla vehicles and iPhones. He explained how Israel's radar platforms can be reconfigured through software updates alone, enabling swift responses to evolving threats.

28. Mr Zohar illustrated the benefits of air-sea domain integration, citing instances where Israeli naval and air forces collaborated effectively to intercept UAV threats through synchronized decision-making and shared operational control. He then highlighted the Israeli Navy's evolving role, noting its increased responsibility in protecting inland assets such as Eilat City and Red Sea installations—an expansion beyond traditional maritime operations. In the fourth insight, he discussed ballistic missile defense (BMD) on naval platforms, referencing the integration of Israeli radar systems aboard German F-124 frigates as a potential model for India's maritime

doctrine. Lastly, he turned to the power of artificial intelligence, sharing how AI-enabled radar systems can now distinguish between drones and birds—a breakthrough in detection accuracy. He introduced the concept of UX (Unmanned Cross-domain) systems, designed to address simultaneous surface and aerial threats, and emphasized the strategic advantage of combining passive and active sensor technologies for stealth and operational effectiveness. Mr Zohar concluded by reinforcing the imperative for nations to remain technologically agile, as the pace and complexity of modern warfare continue to accelerate.

29. The final speaker, Cmde Manav Sehgal, Head of the Indian Navy's Country School overseeing defence systems ranging from small arms to cruise missiles, provided a comprehensive perspective on maritime air defense strategy in the context of current global conflicts. He opened by highlighting the vulnerability of large naval platforms, citing the Ukrainian Neptune missile strike on the Russian cruiser *Moskva* as a defining moment that underscored the disruptive impact of unmanned systems and surprise attacks. Commodore Sehgal noted that unmanned aerial and surface vehicles (UAVs and USVs) are increasingly capable of enforcing sea denial even in the absence of traditional naval superiority. He advocated for a robust, multi-layered defense architecture that integrates ship-borne, air-borne, shore-based, and electronic warfare systems, stressing the need for automation and seamless inter-service coordination to ensure rapid and unified responses.

30. A forward-looking aspect of his talk involved civilian participation in defense; citing Ukraine's EPO app that enables citizens to report drone activity, he proposed harnessing India's civilian tech capabilities to strengthen national surveillance efforts. Addressing the expanding role of naval forces in air defense, he pointed to the Israeli Navy's deployment of Iron Dome systems aboard ships as a model worth considering for India, especially to protect offshore and strategic inland assets. Commodore Sehgal concluded by emphasizing the importance of indigenous capability development and the need for agility in procurement and operational decision-making. He asserted that India's future defense posture must be shaped by doctrinal evolution alongside technological advancement.

31. The closing reflections were delivered by Brigadier M KK Iyer (Retd), who offered a comprehensive view of the strategic defence environment, with particular focus on the Asian subcontinent. He began by emphasizing the primacy of integrated defence

mechanisms, stressing that the growing complexity of regional threats demands a unified approach. Brigadier Iyer called for greater synchronization between the Army, Navy, Air Force, Central Armed Police Forces (CAPF), and civilian systems to ensure coordinated and effective national defence.

32. He further highlighted the need to establish a broader sensor and shooter grid to enable real-time threat management. According to him, such a grid must span multiple domains and platforms to detect and neutralize threats swiftly and efficiently. While he acknowledged the increasing role of automation and advanced technologies in modern warfare, he also made a strong case for recognizing the critical contribution of skilled human operators, whose judgment and adaptability remain irreplaceable. In summarizing the strategic lessons from the session, Brigadier Iyer identified five key takeaways. First, he emphasized technological agility, noting the value of systems that are modular and software-upgradable to keep pace with rapidly evolving threats. Second, he pointed to the growing prevalence of decentralized warfare, where small, low-cost, and hard-to-detect platforms dominate the battlespace. Third, he stressed the need for interoperability, calling for seamless integration and coordination across land, air, sea, and civilian sectors.

33. Brigadier Iyer discussed doctrinal innovation as his fourth point of emphasis, urging that military strategies must evolve in tandem with advancements in technology and the emergence of hybrid threats. Finally, he underlined the importance of national collaboration, asserting that defence is no longer the sole responsibility of the armed forces as it requires active partnerships with civilians, industry, and international allies. Brigadier Iyer concluded by reinforcing the notion that the future of defence lies in building adaptable, integrated systems supported by both cutting-edge technology and collective national effort.

PANEL DISCUSSION 2

ARMED FORCES PERSPECTIVE AND CHALLENGES IN MRSAM: IA/IAF/IN

FEATURING: LT GEN DR A.P. SINGH (RETD) FORMER DIRECTOR GENERAL OF ARMY AIR DEFENCE, COL A.S. BADWAL (RETD), IA, CMDE SAJU JOY, IN AND MR DAN LAUBER, CEO ASI

34. This high-powered session brought together operational leaders from the Indian Army, Navy, and Air Force, alongside senior industry stakeholders from Israel and India, to share practical insights, experiences, and challenges encountered during the induction and operational deployment of the Medium Range Surface-to-Air Missile (MRSAM) system. Chaired by Lt Gen Dr AP Singh (Retd), the panel reflected on the system's performance, inter-service coordination, and roadmap for long-term sustainment. Distinguished speakers included Col A.S. Badwal (Indian Army), Cmde Saju Joy (Indian Navy), and Mr Dan Lauber (CEO, Advanced Systems Integration - ASI).

35. Cmde Saju Joy outlined the Navy's operational experience with MRSAM, particularly the need to maintain high availability during short harbor windows. He detailed the deployment of Special Test Equipment (STE), co-developed with IAI, which allowed critical modules to be swiftly diagnosed and repaired onboard, thus ensuring mission readiness within 48–72 hours. With the establishment of ASI's in-country support and repair facilities, the Navy has moved towards a self-reliant model of MRSAM maintenance. He highlighted how Israeli-designed diagnostic systems are now enabling swift fault rectification within Indian yards, and appreciated the role of IAI and ASI in supporting this transition.

36. Col AS Badwal, who raised and commanded the first MRSAM regiment in the Indian Army, shared a compelling account of how the system was deployed directly into mountainous terrain in the Eastern Theatre—despite being originally intended for plains and deserts. This marked a transformative moment for Army Air Defence, as engagement capabilities expanded from 3.5 km to 70 km missile range with radar coverage of 300 km. He described the challenges of identifying suitable radar sites in rugged terrain, infrastructure limitations, and the need to balance radar activation timing with vulnerability concerns. Despite these difficulties, direct missile hits during operational trials built immense user confidence in the system's performance.

37. Col Badwal further noted that induction was completed in record time, between two to three years, thanks in part to lessons learned from Navy and Air Force deployments. He emphasised that manpower training remains a major hurdle, with each MRSAM unit requiring highly skilled personnel to operate and maintain the system. Although initial training was supported by IAI and conducted in Israel and Indian institutions, there remains a pressing need to institutionalize this capacity locally and scale it across the Army's Engineering and Maintenance branches. He urged OEMs and ASI to continue expanding training coverage, particularly as the system is expected to serve as the mainstay of Army Air Defence for decades.

38. From the industry side, Mr Oded Jacobowitz of IAI emphasized the strategic evolution of the MRSAM program, from a bilateral development effort to a fully integrated, multi-agency ecosystem. He reaffirmed IAI’s long-term commitment to India’s self-reliance goals, citing continuing upgrades, knowledge transfer, and responsiveness to user feedback. Mr Dan Lauber of ASI elaborated on how ASI has matured from a support venture into a central pillar for logistics and maintenance. He introduced STORMS, an advanced AI-enabled digital platform that connects end users in the field directly with engineers, maintenance teams, and decision-makers, across India and Israel, through a single integrated system.

39. STORMS, Lauber explained, is already in use with the Indian Air Force and is being scaled to the Army and Navy. It enables real-time issue identification, predictive maintenance, and transparent resolution workflows, dramatically enhancing operational turnaround and readiness. Built entirely in India, the platform aims to empower users to adapt to shifting requirements and logistical shocks. Lauber emphasized the importance of building such tools today to support continuity over the 25–50-year lifecycle of MRSAM.

40. In his concluding remarks, Lt Gen AP Singh underlined the importance of transitioning from induction to long-term sustainability. He expressed optimism about tools like STORMS in enabling jointness across the three services, while preserving chain of command. General Singh also emphasized the need to evolve training curricula, simulation capabilities, and logistics management across Indian defence institutions in Cochin, Gopalpur, and Gwalior, ensuring that the system’s operational edge is maintained through the next generation.

41. The panel discussion emphasised the MRSAM program not just as a technological success, but as a benchmark for collaborative defence capability building. Its success lies not only in joint development, but in joint ownership, joint deployment, and joint sustainment, across services, OEMs, and national boundaries.

PANEL DISCUSSION 3

SYNERGY AND JOINT MANSHIP: MRSAM IN THE ARMED FORCES

FEAUTRING: LT GEN VIPUL SINGHAL, AVSM, SM, DCIDS, (DOT), HQ IDS, AIR MARSHAL RGK KAPOOR, PVSM, AVSM, VM (RETD), EX AOC-IN-C, CAC AND CMDE SAJU JOY, IN

42. As the summit progressed towards its conclusion, the final panel discussion addressed a topic of strategic and operational relevance: “Synergy and Jointmanship – MRSAM in the Armed Forces.” This session encapsulated the summit’s overarching theme, offering critical insights into the evolution of integrated air defence capabilities within the Indian Armed Forces. The MRSAM program has emerged as a cornerstone of tri-service cooperation, exemplifying effective collaboration between the military, industry, and international partners. In light of the dynamic nature of modern warfare and rapidly advancing threat landscapes, the discussion focused on the need to enhance institutional frameworks for joint planning, coordinated execution, and long-term sustainment. It was acknowledged that successful implementation of such frameworks requires both cognitive alignment and technical integration across services. The panel featured senior leaders with substantial experience in system management, joint operations, and force integration. The session was chaired by Lt Gen Vipul Singhal, AVSM, SM, DCIDS (DOT), HQ IDS. He is responsible for shaping the doctrine, organisational structures, and training paradigms that underpin tri-service integration and jointness within the Indian Armed Forces.

43. Serving as co-chair was Air Marshal RGK Kapoor, PVSM, AVSM, VM (Retd), former Air Officer Commanding-in-Chief, Central Air Command, Indian Air Force. His expertise in operational leadership and system-level induction added significant depth to the discourse, particularly in the context of air defence and joint force application.

44. Commodore Saju Joy also participated as a panelist, contributing naval perspectives on joint capability development, maritime-air integration, and operational deployment of shared systems such as MRSAM. His presence ensured that the discussion remained fully tri-service in scope, addressing the varied operational environments in which such systems are deployed.

45. **Remarks by Lt Gen Vipul Singhal**

- Lt Gen Vipul Singhal opened the session by acknowledging his co-panelists, Air Marshal RGK Kapoor (Retd) and Cmde Saju Joy, and expressed appreciation for the efforts of CENJOWS and ASI in organising the discussion. His address focused on clarifying the conceptual and practical foundations of jointness and integration in the Indian Armed Forces, particularly in the context of the MRSAM system.
- He explained that jointness operates within the cognitive and intangible domain. It is defined by the establishment of trust among the three services and the wider defence ecosystem. This trust is built on mutual understanding, close cooperation, and a unified commitment toward the defence of the nation. Jointness is viewed as a mindset and cultural orientation that supports collaboration in planning and execution.
- In contrast, integration was described as a tangible and operational process. It includes the development and implementation of common systems, networks, training protocols, and procedures to ensure interoperability between services. Without shared networks or compatible infrastructure, seamless communication and coordinated action become significantly more difficult. As such, integration and jointness were presented as interdependent concepts that must progress together to achieve operational efficiency.
- The Indian military has embedded jointness from an early stage in officer training. The National Defence Academy (NDA), a pioneering joint training institution established 77 years ago, serves as a foundational step in building tri-service camaraderie. In recent years, particularly with the formation of the Chief of Defence Staff (CDS) and related organisations, these efforts have gained further institutional momentum.
- Integration efforts are especially relevant in the context of common-use equipment shared across services. While certain platforms, such as naval warships, are inherently service-specific and do not require cross-service integration, several other assets are operated jointly. Examples include Chetak and Cheetah helicopters, Advanced Light Helicopters (ALH), and Remotely Piloted Aircraft (RPAs). These systems, often procured separately by different services, may originate from the same manufacturer but are configured or used differently based on service-specific operational requirements. This divergence poses challenges to standardisation and integration.

- The remarks further stressed the importance of matching the sensor-to-shooter grid across services, a requirement that necessitates common operational networks and protocols. Unified infrastructure and interoperable systems allow for seamless coordination and optimise overall effectiveness of shared platforms such as MRSAM.
- Additionally, integration was highlighted as a key enabler of cost efficiency. Instead of duplicating costly infrastructure such as testing laboratories across services, shared facilities can meet the operational testing requirements of all stakeholders. This consolidation not only reduces expenditure but also accelerates the validation and deployment process.
- The industry's role, particularly that of ASI, was acknowledged as essential in facilitating this vision. ASI was recognised as a model for offering a single-window solution to address service users' needs related to maintenance, indigenisation, and technical support. Such a model eliminates the need for the user to engage with multiple agencies or depend on foreign vendors for support. The approach fosters trust, simplifies coordination, and aligns with broader national objectives of defence self-reliance.
- In concluding his remarks, Lt Gen Singhal noted that while his organisation is responsible for overseeing these integration efforts at the policy and strategic levels, it is the operational commanders and practitioners—such as his fellow panelists—who implement these principles on the ground. He then invited Air Marshal RGK Kapoor (Retd) to share his experiences in handling joint induction and operational integration of the MRSAM system during his service.

46. **Remarks by Air Marshal RGK Kapoor, (Retd)**

- Air Marshal RGK Kapoor (Retd) acknowledged the invitation extended by CENJOWS and ASI, and briefly reflected on the short-notice nature of the engagement, underlining the professional trust and mutual understanding that exist among senior defence leadership.
- He noted that the significance of the topic was all the more emphasised by real-time events, specifically Operation Sindoor, which was unfolding on national television the same day. This operation, he observed, provided a contemporary and live example of synergy and jointmanship in action. According to him, the swift and coordinated application of force during the operation, which achieved operational objectives in a matter of 25 minutes, demonstrated the effectiveness of tri-service coordination, shared planning, and integrated execution.

- He emphasised that the same level of synergy is essential in the domain of air defence, where response time, sensor-shooter coordination, and seamless operational deployment are crucial. Drawing from his experience as an Air Officer involved in the induction process of MRSAM, he clarified that while he had not operated the system directly, he had been closely involved in its planning, induction, and coordination with the Army regarding deployment protocols and operational integration.
- Air Marshal Kapoor offered a fundamental framework for understanding synergy and jointmanship in defence capability development and utilisation. In his view, synergy is fundamentally about getting more from existing resources, which requires effective alignment in four key areas: procurement, provisioning, maintenance, and training. When these elements are harmonised across services, the outcome is greater than the sum of individual efforts, thereby generating operational synergy.
- He further explained that jointmanship should not be confused with superficial indicators such as wearing the same uniform or mere co-location. Instead, it is about the joint operational deployment of systems like MRSAM in a manner that maximises their utility and effectiveness.
- He outlined two fundamental pillars of jointness in air defence operations: operational deployment philosophies and the standardisation of tactics, techniques, procedures (TTPs), including the conduct of joint exercises. These foundational elements, he stressed, are essential to create true synergy between services.
- Referring to national policy, he reiterated that air defence is formally the responsibility of the Indian Air Force under the Union War Book. However, all three services maintain air defence capabilities relevant to their respective operational mandates. The composite task of national air defence thus comprises multiple, interlinked elements—ranging from small components to complex systems—each playing a critical role within a broader, unified structure.
- Air Marshal Kapoor noted that airspace in the contemporary operational environment is highly contested and congested, spanning altitudes from ground level up to 60,000 feet and beyond, encompassing High Altitude Pseudo Satellites (HAPS) and other near-space systems. This necessitates the implementation of a layered air defence architecture, comprising various platforms and weapon systems. These include Very Short Range Air Defence Systems (VSHORADS), Close-In Weapon Systems (CIWS) for anti-drone roles, short-range systems such as SPYDER, medium-range systems like AKASH and MRSAM, and long-range surface-to-air missile systems (LRSAMs).

- Each of these components has a distinct role, and the success of the overall air defence grid depends on defining responsibilities, ensuring interoperability, and establishing a joint operational philosophy. While the services already have well-defined procedures for both peacetime and wartime operations, he stressed that the increasing complexity of modern threats demands continuous refinement and enhanced coordination, particularly between airborne assets and surface-based weapon systems.
- A key concern raised was the global precedent of fratricide (blue-on-blue engagements), which, despite technological advancement and procedural safeguards, remains a significant risk. Kapoor emphasised that the mitigation of such risks hinges on two critical actions: joint planning and joint execution, underpinned by unified protocols.
- One of the principal challenges in achieving this, he observed, is the disparity in systems and doctrines across the three services. These include differences in equipment profiles, manning structures, squadron systems, and maintenance practices. Consequently, when joint systems like AKASH or MRSAM are operated by more than one service, there is a pressing need for protocol standardisation to ensure safe and effective deployment.
- Another concern highlighted was the over-reliance on networks and technology. He pointed out the inherent vulnerability of digital networks to failure, jamming, or cyberattack, and stressed the importance of developing fallback procedures and TTPs to maintain operational effectiveness even under degraded conditions. Ensuring that weapon systems remain potent, resilient, and fratricide-proof in such scenarios, he stated, is a central tenet of true jointmanship.
- Air Marshal Kapoor also acknowledged the ongoing developments such as the Akash-Teer initiative, which is poised to enhance network integration and cross-service interoperability. The convergence of platforms like IACCS and TriKUL is expected to generate substantial efficiencies in deployment, reduce duplication, and allow for optimal utilisation of each air defence unit.
- He concluded by stressing the critical need for operator-level awareness and doctrinal alignment. Every personnel engaged in the operation of MRSAM must fully understand their role within the layered air defence structure—be it in terms of target types, engagement ranges, or network integration.
- Operators must be capable of assessing how these networks can be enabled or disabled, and how such vulnerabilities may impact mission execution. This level of

operational insight is fundamental to the effective employment of joint systems and is central to achieving mission success across the services.

- Kapoor also highlighted the strategic significance of asset deployment within the joint operational environment. Synergy and jointmanship, he noted, depend heavily on coherent and complementary deployment strategies across the three services. He stressed the importance of clearly defining both offensive and defensive roles in the use of air defence systems. While defensive operations are traditionally associated with neutralising threats, he pointed out that such decisions—such as the type of threat and the optimal weapon to engage it—must be made judiciously. For instance, deploying a high-value missile to intercept a low-cost drone is inefficient and must be avoided. This calls for a cost-effective engagement philosophy, integrated into the overall air defence planning.
- He further pointed out that modern warfare is increasingly shaped by the interrelated domains of electronic warfare, cyber, and space. These domains have a direct bearing on the operational integrity of weapon systems like MRSAM. Therefore, it is vital to anticipate and prepare for hostile exploitation of these domains, identify early indicators of cyber or EW attacks, and implement safeguards. Most importantly, he noted, the ability to sustain operations under denied or degraded network conditions must be institutionalised as part of India's jointmanship doctrine.
- While acknowledging that significant progress has been made, Kapoor concluded that there remains considerable scope for improvement, particularly in areas of networking, network security, and resilience. He emphasised the importance of joint training and joint exercises as essential mechanisms to ensure optimal utilisation of air defence systems and to fully realise the objective of inter-service jointmanship.

- Enhancing Operational Synergy and Maintenance Efficiency Across Services: Insights from the MRSAM Program

- Commodore Saju Joy highlighted the imperative of jointmanship through his operational experiences and technical observations regarding the Medium Range Surface-to-Air Missile (MRSAM) system, which is commonly deployed across the Indian Navy, Army, and Air Force. His address focused on key pillars of joint functioning—operations, maintenance, inventory management, and training—as they relate to the effective integration and exploitation of the MRSAM and MF-STAR systems in a tri-service environment.

47. **Operational Challenges and the Case for Joint Procedures**. Drawing from first hand experience while commanding a missile base, Commodore Joy recounted a logistical operation involving the transfer of missiles from an Army unit to a naval installation. What seemed administratively simple soon revealed a series of unforeseen technical challenges—differences in transportation equipment (trailers, cranes, and jigs), aircraft loading mechanisms, and site-specific unloading constraints. These discrepancies underscored the necessity for inter-service dialogue, planning, and procedural standardisation prior to any joint or cross-service operation.

48. He further elaborated that in real operational scenarios—such as forward movement of naval units into regions where the Navy may not have a base—leveraging Army infrastructure and logistics becomes essential. However, for such synergy to be effective, predefined points of contact, storage access, and transportation protocols must be institutionalised. This reinforces the need for procedural clarity and interoperable frameworks to support mission execution.

MF-STAR and MRSAM: Shared Systems, Shared Lessons

49. The MRSAM system, along with the MF-STAR radar, is a significant example of cross-service commonality in equipment. Commodore Joy pointed out that the Navy began inducting this system in 2016, followed subsequently by the Army and the Air Force. He stressed that shared operational experiences across the services—particularly lessons learned from deployment and firing serials—have contributed immensely to enhancing joint performance. Regular dialogue and collaborative analysis of these lessons have allowed each service to benefit from the other's evolving operational practices and procurement developments.

Establishing a Unified Maintenance and Operational Framework

50. To institutionalise synergy, a structured inter-service mechanism has been established under the Principal Maintenance Officer (PMO) framework. This tri-service body, headed by a three-star officer, oversees all joint maintenance activities. Within this framework, a dedicated Integrated Maintenance Working Group (IMWG) has been formed specifically for the MRSAM system.

The IMWG addresses the following critical areas:-

- **Common Inventory Visibility:** A system to ensure real-time awareness of available spares, modules, and components across all three services. This enables efficient resource allocation, especially for critical components.

- **Standardised Procedures:** By evaluating service-specific practices, the IMWG has identified best practices and aligned them into a unified procedural doctrine that all services now follow.

- **Shared Lessons and Continuous Improvement:** The group routinely evaluates lessons from firing exercises conducted by the Navy, Army, and Air Force. Quarterly meetings are held at various service units where operational challenges are analysed and procedural recommendations are formulated collaboratively.

- **Industry Support Platforms:** Commodore Joy also acknowledged the contribution of private sector players such as ASI, which developed key modules like STORMS. These platforms play a pivotal role in enabling a common technological interface for all three services, thereby facilitating smoother coordination and logistics.

51. Cmde Saju Joy concluded by reaffirming the criticality of jointmanship not only in operations but also in maintenance, inventory sharing, and training. Through structured mechanisms such as the PMO and IMWG, and with active support from industry partners, the Indian Armed Forces are making tangible progress toward seamless tri-service integration in air defence operations.

PRESENTATION BY DR MAHESH RAJPUROHIT, PROGRAM DIRECTOR OF MRSAM (IA AND IAF), TITLE: JOURNEY OF JOINT VENTURE & INDIGENISATION

52. In the session on Journey of Joint Venture and Indigenisation, Dr Mahesh Rajpurohit, the Program Director of MRSAM (IA and IAF), pointed out that the India-Israel defence partnership represents far more than a transactional relationship—it is a civilizational and strategic collaboration. Referencing the Battle of Haifa in 1918, he set the tone for a presentation that was both technically rigorous and philosophically grounded. Speaking from his experience leading the MRSAM program, Dr Rajpurohit described how the journey began in 2006 with limited indigenous involvement but evolved into a robust joint venture, achieving a 50% Indian workshare by 2017 itself.

53. He reflected on his own transformation “from a scientist into a soldier,” underlining the personal commitment an d emotional investment that defined the program’s success. Dr Rajpurohit shared that one of the program’s core design principles was to develop lightweight, cost-effective, and highly mobile systems that could be deployed across India’s varied terrains—deserts, plains, and mountains. The emphasis was on systems operable by compact teams, ideally fewer than 100 personnel, to reduce logistical burden. Using the metaphor “shoes are more important than brains,” he highlighted the centrality of mobility in modern combat scenarios.

54. **Key Takeaways/Challenges**

- Addressing engineering challenges, he explained how the systems were designed to function in extreme conditions, from -30°C to +70°C, and to withstand high humidity and monsoon environments. Existing commercial vehicles were not suitable for transporting MRSAM payloads, prompting indigenous development efforts in collaboration with companies like Ashok Leyland and Tata Motors. The creation of India’s first 12x12 chassis capable of carrying a 24-ton payload was noted as a breakthrough moment in domestic defence manufacturing.
- Despite the scale and complexity of the task, the development team remained lean, comprising just five scientists and fewer than 15 engineers. Dr Rajpurohit credited the Israeli partners for their contribution, especially in the areas of documentation, system reliability, and structured training. He shared how the team’s success was not just due to technical ability but also their flexibility and responsiveness. For instance, when end-users requested last-minute modifications, the team adapted “like a mother,” prioritizing practicality and user-centric design.

- He also spoke with conviction about the ethical philosophy underpinning defence R&D, stating, “We do not develop weapons for unfortunate users; we develop weapons for our sons.” This mindset, he argued, compels scientists to treat every design flaw as a potential threat to a soldier’s life. He compared flawed systems to “polio”—a condition that must be prevented at all costs through precision, foresight, and accountability.
- Dr Rajpurohit emphasised the strength of the Indo-Israel collaboration model, noting that regular monthly visits by Israeli experts helped bypass bureaucratic delays and accelerated innovation cycles. Real-time collaboration and mutual respect between the two sides played a crucial role in the project’s timely success.

55. In conclusion, the session highlighted how human-cantered design, indigenous innovation, and strategic partnerships enabled the MRSAM program to evolve into a globally competitive defence system. Dr Rajpurohit’s address was both a technical narrative and a deeply personal reflection, reinforcing that mission-driven leadership and empathetic engineering are key to building defence systems that not only protect borders but honour the lives of those who serve.

PRESENTATION BY MR GIRISH PRADHAN, EXECUTIVE DIRECTOR MARKETING BDL, TITLE: PRODUCT EVOLUTION AND OVERCOMING OBSTACLES

56. Mr Girish Pradhan, in his lecture, delivered a comprehensive overview of the complex, collaborative, and technically demanding journey involved in the development of the MR-SAM (Medium Range Surface to Air Missile) system, highlighting its evolution from conceptualization to induction. His talk, rich in detail and grounded in decades of experience, shed light on both the technological and organizational challenges faced throughout the project.

57. He began by emphasizing the immense coordination required between multiple stakeholders across two continents—India and Israel—underlining that this was not just an ordinary defense project, but one that demanded exceptional synergy between aeronautical scientists, industrial partners, technical experts, and armed forces. Despite what might appear to be a seamless execution on paper, the actual development was fraught with complications stemming from the scale and ambition of the program. The MRSAM was not merely a product of advanced technology, but also of sustained partnership and relentless effort.

58. **Key Takeaways/ Recommendations**

- The initial success came after the completion of the first developmental phase. However, Mr Pradhan noted that the subsequent phase, focused on aligning and validating technologies, presented significant hurdles. Rigorous testing had to be carried out under a variety of extreme Indian environmental conditions such as high altitudes, deserts, heavy snow, and rain. These were essential to ensure the missile system's combat-worthiness and adaptability. Testing alone required seamless collaboration across institutions and countries, integrating military needs with industrial capabilities.
- He elaborated on the vital role played by Indian defense industry players such as Bharat Electronics Limited (BEL) and the Aeronautical Development Agency (ADA). BDL assumed the role of the prime missile integrator, responsible for establishing production setups and robust processes. Significantly, BDL fostered a sustainable ecosystem involving MSMEs and forged long-term relationships with supply chain partners. Parallelly, efforts were made to integrate radar units, command systems, and auxiliary components into a cohesive weapon platform, achieving interoperability and system agility.
- Among the key developmental challenges, Mr Pradhan highlighted two in particular. The first involved the development of the main propulsion system and its propellant composition, a process laden with scientific complexity due to the intricate relationship between the missile's mass-to-length ratio and its thrust consistency. Overcoming this required innovation in material handling protocols, curing, casting, and quality control. It was a process of repeated trial and error, extensive brainstorming, and strong belief in teamwork.
- The second major hurdle pertained to the integration of the rocket motor with critical missile components such as the seeker, airframe, control surfaces, and the launch canister. This integration demanded high-precision manufacturing and alignment—tasks undertaken in India for the very first time. He candidly pointed out that what may look simple in a drawing becomes a formidable challenge in actual implementation, often riddled with small yet time-consuming complications.
- Moving to production challenges, Mr Pradhan emphasized that translating a development model into consistent, large-scale production was perhaps the most complex phase. Missiles, being single-shot devices, must perform with absolute reliability even after long periods in storage. A failure rate as small as 0.1% is

unacceptable. Therefore, achieving this standard necessitated not only strategic alignment and rigorous testing, but also the qualification and development of numerous domestic vendors—a slow and expensive process.

- He acknowledged the logistical issues faced during production—many components had to be sourced internationally, and several vendors had to be developed and certified domestically. Despite these challenges, the industry showed adaptability, innovated processes, and strengthened procedures, culminating in a robust and sustainable production chain. By 2014, the MR-SAM system was cleared for production, although validation trials continued until 2022.
- Mr Pradhan proudly stated that through over a decade of deep involvement, BDL demonstrated its ability to absorb advanced technology, improve system capabilities, and provide lifecycle support. This not only aligned with India's strategic goal of self-reliance but also helped meet the growing requirements of the Indian Armed Forces.

59. He concluded by pointing to persistent challenges such as maintaining resilient supply chains, managing lead times, and ensuring availability of high-quality components. He also touched upon critical issues around pricing, quality, and timely delivery. Nevertheless, he expressed confidence in India's potential to become a global supplier in missile systems, thanks to its strong and evolving defense ecosystem.

60. Summarizing the spirit of the collaboration, Mr Pradhan ended with an inspiring quote: "Alone, we can achieve so little; together, we can achieve the unthinkable." He reiterated that continued collaboration, technological innovation, and user-driven development will enable India's defense industry to meet future warfare demands more effectively, making the nation's skies safer and its strategic position stronger.

PRESENTATION BY MR RAJNISH SHARMA, CHAIRMAN BIA AND DIRECTOR BANGALORE COMPLEX, BEL, TITLE: PRODUCT EVOLUTION AND OVERCOMING OBSTACLES

61. In his address, Mr Rajnish Sharma, Director of the Bangalore Complex of Bharat Electronics Limited (BEL), outlined the journey, challenges, and milestones in the realisation of the MRM equipment (Missile Remote Monitoring system) being supplied to the Indian Navy. Mr Sharma's speech reflected not only a technical and logistical narrative but also highlighted the importance of collaborative ecosystems, technological capability-building, and the resilience shown during unprecedented times.

62. At the outset, Mr Sharma expressed his deep gratitude and pride in being part of the platform, emphasizing that BEL has undertaken the supply of MRM equipment with strategic seriousness, given its importance to national defense. The order for 11 MRM systems was placed by the Indian Navy for deployment on 15 BRAHMOS-equipped ships, around the year 2018. This was a landmark moment for BEL as it was the first time the organisation was supplying such a system to the Navy, necessitating the establishment of a dedicated Strategic Business Unit (SBU) to manage the complex project.

63. **Key Takeaways/Recommendations**

- One of the major turning points in this journey was the onset of the COVID-19 pandemic, which posed enormous challenges to project execution. With international travel restrictions in place and in-person training rendered impossible, BEL, in close partnership with its Israeli collaborators, had to conduct training through virtual channels. Despite these constraints, BEL managed to set up the MRM Assembly facility during the 1.5-year COVID-affected period, demonstrating commendable agility and resourcefulness.
- Mr Sharma was particularly appreciative of the technical handholding provided by the Israeli partner throughout the process. This involved real-time virtual collaboration for training Indian officers and technicians. The collaborative spirit between the two nations during this period, according to Mr Sharma, represents a true hallmark of the Indo-Israeli defense cooperation.
- In terms of project progress, Mr Sharma shared that five of the eleven MRM systems have already been delivered and installed on ships, and have undergone successful trials and evaluations. The remaining systems are in advanced stages of realisation, with the final unit expected to be delivered by the same time next year.
- A significant portion of Mr Sharma's address focused on the development of the indigenous ecosystem and the strategic intent behind engaging with Micro, Small, and Medium Enterprises (MSMEs). He emphasized that building an ecosystem was perhaps the biggest challenge encountered during the project. Given the sophisticated nature of MRM systems—being at the cutting edge of missile technology—the realisation of these components demanded high levels of technical competence. BEL, as a public sector undertaking, considers it both a duty and a responsibility to ensure that Indian MSMEs are actively involved and nurtured in such critical projects. This approach, he noted, is in line with the true

spirit of the Atmanirbhar Bharat (self-reliant India) initiative, as reflected in the current defense industrial policy.

- Mr Sharma credited the Israeli partners for helping BEL identify and establish connections with capable channel partners within the country who could manufacture high-tech components locally. This collaborative approach was instrumental in ensuring timely delivery and quality assurance despite the odds posed by the pandemic and the novelty of the system.
- Another crucial element in the MRM program's success, as per Mr Sharma, was the focus on competency and capacity building within BEL's own workforce. While external assistance and technology transfer played their part, it was imperative that BEL's engineers and officers attained the necessary competencies to independently manage and execute such complex projects. To this end, BEL instituted multiple rounds of in-house training, simulation exercises, and participatory trials for its teams. These efforts have paid off, as BEL personnel are now fully equipped to handle trials and evaluations independently, without requiring constant support from foreign partners.

64. Mr Sharma concluded by reiterating his gratitude to all stakeholders, particularly the Indian Navy, Israeli collaborators (IAI), and ASI (Aerospace Service India), for their unflinching support and trust. He emphasised that the success of this MRM project symbolizes the growing technological synergy between India and Israel, which now extends into the broader realm of missile systems integration for tri-service applications (Army, Navy, and Air Force).

65. The address ended on an optimistic note, suggesting that the BEL-Israel partnership had matured into a robust model for future high-tech defense projects. Mr Sharma underlined that India's defense manufacturing capabilities, when backed by focused training, international cooperation, and a robust MSME ecosystem, are capable of delivering sophisticated systems tailored for modern warfare.

PRESENATION BY MR BHASKAR PURI, SENIOR MANAGER AT INVEST INDIA,

TITLE: PRIVATE INDUSTRY PERSPECTIVE

66. In a detailed and persuasive presentation, Mr Bhaskar Puri, Senior Manager at Invest India, addressed a broad audience of international stakeholders and prospective investors, specifically within the aerospace and defence sector, at a session oriented around exploring India as a destination for foreign defence manufacturing and R&D.

While the event may have had a thematic focus on the Indo-Israeli relationship and Israel Aerospace Industries (IAI) in particular, Mr Puri's presentation expanded the scope to encompass global defence manufacturers considering India as a base for setting up operations in manufacturing, services, and maintenance.

67. Mr Puri began with an introduction to Invest India, the national investment promotion and facilitation agency under the Ministry of Commerce and Industry. Describing it as an autonomous body that reports directly to the Secretary of the Ministry, he highlighted its core mission of attracting and supporting foreign investment across sectors. As the defence and aerospace lead within the organization, Mr Puri described Invest India as the crucial interface between the government (both central and state), industry bodies, foreign missions, and private sector actors. The agency provides end-to-end support, from opportunity assessment and market entry strategies to policy navigation, regulatory clearance facilitation, and post-investment aftercare.

68. **Key Takeaways/Recommendations**

- Turning to the core of his pitch, Mr Puri painted a comprehensive picture of India's aerospace and defence ecosystem and its potential. With one of the largest armed forces in the world, a massive land and coastal border to defend, and over 1.4 million active personnel, India represents not just a major defence power but also a large market with extensive capability-building needs. The national defence budget stands at approximately USD 76 billion, making it the fourth largest globally. Out of this, around USD 20.45 billion is earmarked specifically for capital expenditure, signalling robust opportunities for industrial and technological collaboration.
- Mr Puri drew attention to the liberalized Foreign Direct Investment (FDI) norms in defence: up to 74% FDI is allowed under the automatic route and up to 100% under the government route for investments involving advanced or niche technology. Moreover, India is rapidly increasing its domestic defence production capacity, currently valued at around USD 15 billion, with a growing export base that already includes 85 countries. Although offset obligations have been gradually phased out, projects above INR 4,000 crore still carry a 30% offset requirement, which could be leveraged strategically by foreign firms.
- India's push for defence self-reliance was another core element of the presentation. Over 90% of acquisition orders from the Ministry of Defence in the past financial year went to Indian firms, up from 75 % in the year 2023. Around

400 weapon systems and approximately 4,500 major Line Replaceable Units (LRUs) are now included in a positive indigenization list. In parallel, India is promoting research and innovation—25% of the Ministry of Defence's R&D budget is now allocated to the private sector, and a reasonably high fund has been created to support industry through long-term loans.

- Foreign participation has also been on the rise. Over 70 international defence companies are operating in India, contributing to over USD 300 million in FDI in defence manufacturing. Mr Puri commended IAI in particular as one of the most significant contributors to this trend, while encouraging other firms to expand their portfolios into areas such as aerostructures, small arms, composites, aero engines, and critical materials.
- He then spotlighted the two dedicated Defence Industrial Corridors (DICs) in Uttar Pradesh and Tamil Nadu, which have emerged as regional manufacturing ecosystems. The Northern Corridor in UP has become a hub for small arms, munitions, and protective equipment, while the Southern Corridor Tamil Nadu has developed capabilities in aerospace components, radars, and avionics. Both corridors boast enabling infrastructure, state support, and sector-specific policy incentives, making them attractive options for greenfield and brownfield investments.
- Mr Puri also highlighted India's massive upcoming defence requirements, including projects related to field artillery, light tanks, PGM-equipped helicopters, deck-based fighter jets, drones, and more. The Indian Air Force's MRFA, AMCA, and transport aircraft programs alone represent vast opportunities for global collaboration.
- Particularly addressing Israeli companies, Mr Puri emphasized the strong existing foundation of Indo-Israeli defence cooperation and encouraged further expansion into manufacturing and R&D within India. He presented compelling cost advantages, noting that manufacturing in India can offer a 16–20% cost reduction compared to Europe, with additional savings of up to 20% in capital expenditure if firms leverage defence corridors. The Indian R&D ecosystem also presents high value, with researcher hiring costs just one-fifth of the global average—making it viable not only to serve Indian demand but also to support Israeli and other international requirements through Indian operations.

69. In closing note, Mr Puri made a firm appeal to Israeli and global defence firms: India is not only a strategic partner with growing demand and a pro-investment policy environment, but it also offers tangible cost advantages, skilled human capital, and an increasingly robust manufacturing and R&D base. Whether through partnerships, joint ventures, or independent operations, now is the right time to go “all out” on investment and expansion in India’s aerospace and defence ecosystem.

PRESENTATION BY MR YATAN MISHRA, HEAD ENGINEERING, WEAPON SYSTEMS AND SENSORS DIVISION, TASL, TITLE: PRIVATE INDUSTRY PERSPECTIVE

70. Mr Yatan Mishra provided a comprehensive overview of the diversified and technologically advanced defense portfolio of Tata Advanced Systems Limited (TASL), highlighting the company's core divisions, capabilities, and challenges in the Indian defense sector. TASL’s engineering and manufacturing strength spans four major verticals: Global Supply Chain, Platform & Cell Systems, Weapon Systems & Sensors, and Land Mobility.

71. Starting with the Global Supply Chain, Mr Mishra explained how TASL has established a robust foundation by contributing significantly to aerospace and defense systems integration. The Platform and Systems division, he noted, is primarily involved in Unmanned Aerial Vehicles (UAVs), loitering munitions, and various unmanned systems. These platforms cater to both offensive and surveillance applications and are central to TASL’s innovation drive.

72. The Weapons and Sensors Systems division, which Mr Mishra leads, specializes in artillery launchers, electronic warfare systems, automated data platforms, and satellite-based applications. This division plays a crucial role in enhancing the precision and effectiveness of Indian defense capabilities. Furthermore, Land Mobility focuses on the development and supply of tactical and armored vehicles for India’s armed forces. These vehicles range from standard utility carriers to advanced mobility solutions integrated with combat-ready systems.

73. Mr Mishra emphasized TASL’s significant capabilities in defense digitization, where systems range from battlefield tablets to rugged servers capable of supporting field operations, sensor integration, and advanced electronic warfare (EW) systems.

The company is actively involved in the modernization of air infrastructure, offering integrated warfare systems and contributing to the evolution of next-generation command and control architectures.

74. He further highlighted TASL's leadership in electro-optical (EO) systems, ranging from basic binocular devices to long-range surveillance systems, which are now not only deployed across Indian forces but also exported globally. TASL is also investing in border security and maritime management systems, where indigenous development of EO sites and sensor fusion engines has enhanced situational awareness for military operations.

75. Drawing attention to TASL's heritage, Mr Mishra underlined that the company has been engaged in defense-related research and development (R&D) since 1974 and now has nearly amassing nearly five decades of experience. TASL has built extensive production and testing infrastructure, including environmental testing labs, electromagnetic pulse (EMP) test chambers, and system integration facilities. He explained that the longest phase in defense manufacturing is often testing and validation, which TASL has streamlined through these facilities.

76. He provided insights into the various products under development, particularly artillery and armored systems. In terms of launchers, TASL has worked on Multi-Rocket Launchers (MRLs) and various launcher variants for both the Indian Army and Air Force. Mr Mishra specifically noted TASL's contributions to the development and integration of launchers in MR-SAM (Medium Range Surface-to-Air Missile) systems, where the company has delivered over 79 launchers to date.

77. While discussing challenges, Mr Mishra pointed out several systemic and technological hurdles. One key issue is the over-reliance on MoD-defined subsystems, which may not align with operational requirements at the system level. Another is the integration of hot items in systems designed to operate at extreme temperatures and environmental conditions—posing long-term sustainability issues. Moreover, the dependence on self-items (proprietary, custom-built components) leads to rapid development cycles but presents difficulties in long-term support and upgrades. He also flagged geopolitical and import restrictions as barriers to sustaining systems over time, particularly when key components are sourced internationally.

78. To address these issues, Mr Mishra outlined a way forward. He advocated for the modularization of defense systems, where key subsystems and core modules are identified and developed independently to improve agility and resilience. This approach would enable rapid development and quicker acceptance cycles, essential in modern warfare. He also recommended creating multiple alternative sourcing options to avoid dependency on single vendors or nations, ensuring continuity in production and service. Mr Mishra assured the audience that the Indian defense industry, particularly TASL, is now mature enough to lead this transformation.

79. In closing, Mr Mishra reaffirmed TASL's commitment to building a self-reliant, agile, and innovation-driven defense ecosystem in India. Through its integrated facilities, long-standing R&D focus, and comprehensive product portfolio, TASL is well-positioned to meet the current and future needs of Indian armed forces while also expanding its global footprint.

MR KAUSHAL JADIA, SR VICE PRESIDENT STRATEGY, TECHNOLOGY, CYIENT-DLM, TITLE: PRIVATE INDUSTRY PERSPECTIVE

80. In his address, Mr Kaushal Jadia, Senior Vice President of Strategy and Technology at Cyient DLM, offered an insightful overview of Cyient's operations, growth trajectory, and its significant role in India's evolving electronics and defence manufacturing ecosystem. He began by introducing Cyient as a 32-year-old, $500 million revenue organization with a global footprint, structured into three key verticals: Cyient D&T (engineering and technology services), Cyient Semiconductor, and Cyient DLM (Design Led Manufacturing), the last of which he represents.

81. Cyient D&T forms the engineering backbone of the group, employing nearly 16,000 people across various countries and deriving a substantial part of its revenue—about 33%—from the aerospace sector. The company has been a leading supplier to global aerospace giants like Pratt & Whitney, Honeywell, and others, with a robust legacy of productivity and innovation. Cyient Semiconductor, a newer but fast-growing entity, focuses on mixed-signal design for safety-critical applications across medical, aerospace, and defence sectors, with offices in Hyderabad, Dallas, and other tech hubs. It specializes in gallium nitride (GaN) and silicon carbide (SiC) technologies—emphasizing power-focused semiconductor design for niche applications.

83. **Key Takeaways/Recommendations**

- Mr Jadia's main focus related to the involvement in end-to-end design-led manufacturing, covering circuit card assemblies, wire harnessing, and box builds for both commercial and safety-critical domains. He highlighted the sector's tremendous growth—averaging a 30% CAGR, and pointed out as to how government incentives and the rise of consumer electronics have catalyzed demand. For FY2024, Cyient DLM closed with reasonably high revenue, with a balanced focus on built-to-print and build-to-spec solutions.
- Mr Jadia also touched on Cyient's strategic collaborations, particularly with Israeli defence entities like IAI and Elta since the late 2000s. These long-standing partnerships, forged through rigorous selection processes, led Cyient to manufacture complex transmit-receive modules and UHF components, successfully transitioning from imported Israeli modules to local manufacturing for DRDO, Bharat Electronics, and other Indian defence PSUs. This engagement, he noted, was a testament to the company's capabilities in mastering complex technologies.
- In emphasizing Cyient's strengths, Mr Jadia underscored the critical cross-linkages between commercial aviation and defence electronics. He cited Cyient's certification in designing and manufacturing Line Replaceable Units (LRUs) for commercial aircraft, which conform to stringent global safety standards like EASA DAL-B. These capabilities naturally align with the demands of defence systems and showcase India's latent ability to scale safety-critical electronics production to meet both commercial and strategic requirements.
- Transitioning into policy and technological prospects, Mr Jadia elaborated on the need to revamp dated systems like initial sessions of MRSAM and other radar platforms, which, while operationally effective, suffer from technological obsolescence. He argued that the average semiconductor lifecycle (NEK) spans only 6–12 years, necessitating proactive obsolescence management. He also highlighted opportunities in antenna design improvements (e.g., expanding angular coverage beyond ±60 degrees) and leveraging new materials to enhance performance.
- A central point in Mr Jadia's talk was the untapped potential of India's semiconductor design ecosystem. He encouraged deeper collaboration with Indian academic institutions and design houses to integrate locally designed

components, such as LNA and power amplifiers, into strategic systems. This, he emphasised, would reduce India's dependence on long-lead international supply chains and improve strategic autonomy. Further, with the government's push for OSAT (Outsourced Semiconductor Assembly and Testing) facilities in India, there is now an ecosystem emerging for end-to-end chip design and packaging.

- He also addressed potential innovations in processing and sensor systems, suggesting that defence systems can draw from advancements in the automotive sector. Technologies like MIMO (Multiple Input Multiple Output) radars and AI-driven camera systems—commonplace in autonomous vehicles—can offer modern alternatives to legacy defence sensors. Passive sensors, computer vision, and edge processing using deep learning can effectively substitute or complement traditional infrared and thermal sensors in some contexts.
- Mr Jadia urged Israeli and other international partners to consider the advantages of designing in India, pointing to a potential 50% reduction in one-time design costs and 15–20% savings in series production costs. These numbers provide a compelling business case for localization—not only for cost competitiveness but also for proximity to an emerging, high-quality talent base. He called for a co-development model where IP may reside with foreign OEMs, but design, integration, and partial production can take place within India to create a resilient, collaborative ecosystem.

84. Finally, he recommended integrating local Indian vendors and MSMEs into digital logistics systems like ASI (Advanced Supply Integration) to improve forecasting and preparedness. Highlighting challenges with component procurement cycles—sometimes as long as 50 weeks—he advocated for enhanced visibility of armed forces' requirements to ensure timely readiness. He concluded by reaffirming Cyient's commitment to contributing to India's defence and electronics ecosystem and welcomed collaborations that blend innovation, localization, and business feasibility.

85. Mr Jadia's address underscored Cyient's technological depth, its integration across strategic industries, and the rich opportunities ahead for building a self-reliant, innovative, and globally competitive defence-electronics ecosystem in India.

PRESENTATION BY DR SAMSON, CEO BIA, TITLE: INDIGENISATION DRIVE SYNERGY BETWEEN IAI AND BEL

86. Dr Samson, CEO of BIA (Bell-IAI Advanced), delivered an insightful address during the conference reflecting his technical expertise. His speech centered on the foundational philosophy and operational architecture of BIA, a joint venture between Israel Aerospace Industries (IAI) and Bharat Electronics Limited (BEL), which operates under a "Single Point of Contact" (SPOC) model. The venture was established to offer exclusive support services for defence systems, particularly those under the MSME (Make in India) framework. Today, BIA is actively engaged with the Indian Army, Navy, and Air Force, reflecting deep integration and partnership with Indian armed forces.

87. **Key Takeaways/ Recommendations.** Dr Samson structured his address using a metaphor of constructing something great, which, according to him, requires three elements: a solid foundation, the right tools, and the right partners.

- **Foundation – Trust:** The cornerstone of BIA's operations, according to Dr Samson, is trust. Trust among the armed services, between the defence industry and stakeholders, and within government departments is paramount. This foundation, he argued, allows for robust collaboration and the efficient deployment of technological solutions.
- **Tools-Capability and Innovation:** He emphasized that the very event they were attending was proof that India possesses the right tools—technological capabilities, innovation pipelines, and institutional knowledge—to respond effectively to future defence challenges. The ecosystem built around BIA includes advanced support systems, integrated logistics, and maintenance innovation, which are all key tools in their arsenal.
- **Partners-Deep Collaboration:** In terms of partnership, Dr Samson underlined the depth of cooperation not only between IAI and BEL but also with the tri-services (Army, Navy, Air Force) and broader industrial stakeholders. BIA serves as a bridge integrating local expertise with global experience, all while ensuring that transactions and services are rooted firmly in Indian systems and currency (rupees).
- **Dr Samson presented BIA's operational model, represented in a visual triad:** on one end, IAI and BEL with their full ecosystem and entities; in the middle, BIA as the integrative SPOC; and on the other end, the Indian armed forces. This configuration ensures seamless alignment and execution of services,

logistics, and technology support. To capture BIA's vision, he introduced an acronym: SPARK—

- Service: Delivering exceptional service and support
- Partnership: Fostering collaboration among nations, services, and companies.
- Advance: Leveraging cutting-edge technology and systems.
- Reliable: Ensuring consistent system availability and minimal downtime.
- Knowledge: Harnessing institutional and field knowledge to improve services and solutions.

- **Each pillar of SPARK** was elaborated with a mix of operational detail and philosophical underpinning. He reiterated the importance of improving system availability and reducing downtime as core goals of BIA's mission. This, he emphasized, would enhance overall defence readiness and efficiency.
- **Dr Samson also briefly discussed innovative service delivery models like Vendor Managed Inventory (VMI) and Performance-Based Logistics (PBS),** which are being considered or implemented to streamline support services under BIA's umbrella.
- **In a forward-looking segment of his address**, he highlighted a major strategic initiative: the India-Middle East-Europe Economic Corridor (IMEC). Though not strictly limited to defence, this infrastructure project will play a transformative role in regional and global supply chains. By connecting Mumbai to the UAE, and then through Haifa (a port currently owned by an Indian company) to Europe, the corridor aims to establish a resilient and economically integrated trade route. Dr Samson emphasized its potential to enhance not only commercial links but also defence-industrial collaboration, stating confidently that "when—not if—this happens, the results will be remarkable."

88. He concluded his speech with a metaphorical story of a river and a dam, symbolizing the energy of ideas (the river) and the structure of institutions (the dam). When working separately, their impacts are limited. But when they cooperate, the river's energy is channeled, and the dam gains life and purpose—together producing power and hope. This, Dr Samson reflected, is the essence of the collaboration between BIA and the Indian defence ecosystem—each partner complementing the other's strengths to create greater synergy and effectiveness.

89. In summary, Dr Samson’s address encapsulated the strategic importance of trust-based partnerships, the integration of innovative service tools, and the leveraging of global-local synergies to advance India’s defence readiness. His speech was a call for deeper engagement, smarter service models, and visionary planning—all aimed at building a more self-reliant and capable defence ecosystem for India.

CLOSING REMARK: MAJ GEN (DR) ASHOK KUMAR, VSM (RETD)

90. In his closing address at the seminar, Maj Gen (Dr) Ashok Kumar, VSM (Retd), Director General of the Centre for Joint Warfare Studies (CENJOWS), delivered a candid and reflective speech that captured both the aspirations and realities of India's defense ecosystem. He thanked the audience for houseful participation despite commencement of Operation Sindoor.

91. Maj Gen Kumar emphasized the strategic importance of the event, not only from a defense and technological standpoint but also as a crucial step in further deepening the bilateral relationship between India and Israel. He highlighted the alignment of national interests and the convergence of strategic imperatives between the two countries, noting that despite external disruptions and scheduling challenges, the partnership remains vital and full of potential.

92. He extended heartfelt gratitude to Col Harison Verma from ASI for initiating the idea and working closely with the team at CENJOWS to bring the event to fruition. He praised the seamless organization—from entry procedures to overall execution—and lauded the professionalism of the CENJOWS and ASI team. Expressing optimism, he hoped that the event would leave lasting memories and mark the beginning of deeper business relationships and strategic cooperation between the defense industries of both nations.

93. Dr Kumar then spoke at length about the role of CENJOWS, one of the few Indian think tanks directly working under the Integrated Defence Staff (IDS), Chief of Defence Staff (CDS), and the Ministry of Defence. He encouraged the attendees to explore CENJOWS' resources and outputs through their open-access website, which reflects their vast engagement across military strategy, technological integration, and policy research.

94. Touching on the broader context of national security and self-reliance, Maj Gen Kumar stressed the importance of indigenization. He made a clear distinction: indigenization does not equate to excluding foreign players, but rather calls for

meaningful, collaborative partnerships that fill India’s technology gaps and help build sovereign capabilities. The central argument: that India must develop, control, and maintain critical defense capabilities domestically to ensure true strategic autonomy.

95. He also noted that India’s aspiration to become a developed nation by 2047 hinges on strong defense capabilities. Currently, the world’s fifth-largest economy, India is on track to become the third-largest economy in the near future, and this ambition requires robust security infrastructure. He identified Israel as a critical partner in this journey, praising its technological prowess and battle-tested systems. The everyday testing of Israeli equipment under real battlefield conditions, he noted, makes their systems reliable and valuable for India’s needs.

96. Maj Gen Kumar concluded with a nuanced understanding of co-development and co-manufacturing models. He pointed out that India possesses advantages in geography and security due to vastness of its interior regions, which are relatively insulated from external threats. This makes India an attractive location for defense manufacturing—not just for self-reliance, but also as a potential supplier for global partners. He expressed hope that Israeli defense companies would see value in this model and invest in joint production and innovation with Indian partners.

97. In his final words, he thanked the audience for their patience and participation and expressed hope for continued collaboration in different formats, forums, and engagements going forward. The overarching message was clear: India's path to secure, self-sustained defense readiness depends on indigenization, trusted international partnerships, and a committed ecosystem where knowledge, technology, and trust converge.

MAJOR INSIGHTS OF THE SEMINAR

- **Air Defence Must Be Multi-Tiered and Indigenised.** The seminar underscored the urgent need for a layered air defence system, Army Air Defence Gun System, short, medium, and long-range missiles including drones, cruise missiles, and UAV swarms and their counter weapons. India's MR-SAM program, jointly developed with Israel, was highlighted as a model of strategic autonomy and indigenisation, now deployed across the Army, Navy, and Air Force.

- **Jointness and Interoperability Are Strategic Imperatives.** Multiple sessions stressed the shift from siloed doctrines to integrated joint operations. Unified command-and-control, real-time data fusion, and platform interoperability across services were emphasized as crucial for future warfare.

- **Lessons from Ukraine and Israel Reinforce Real-Time Adaptability.** Case studies from ongoing wars showed that success depends not just on advanced weaponry, but on adaptive C2 systems, agile engineering feedback loops, and decentralized decision-making. Militaries must evolve continuously during combat, not just between wars.

- **Private Sector and MSMEs are Central to Defence Capability.** Indian firms like BEL, BDL, TASL, and Cyient showcased their growing role in technology absorption, lifecycle support, and defence digitisation. Collaborations have moved beyond co-assembly to innovation-driven manufacturing with increasing Indian workshare.

- **India Positioned as a Global Defence Manufacturing Hub.** With liberalised FDI policies, industrial corridors, and skilled talent, India was projected as an ideal location for foreign defence investment, co-development, and R&D partnerships, especially for missile systems, radar, semiconductors, and launchers.

MAJOR RECOMMENDATIONS

- **Institutionalize Embedded Human-Machine Feedback Loops.** Drawing from Israeli defence practices, India should integrate dual-role operational-engineering teams where frontline personnel directly influence system design and software updates. This model accelerates adaptation, minimizes design flaws, and transforms the battlefield into a continuous learning space.
- **Create a Centralized, AI-Driven Maintenance and Training Ecosystem.** Develop platforms like STORMS across all services to connect end-users, technicians, OEMs, and decision-makers in real-time. This should be integrated with an indigenous, tri-service training ecosystem to reduce reliance on foreign OEMs and ensure readiness over a 25–50-year lifecycle.
- **Launch a Modular, Upgradeable Design Doctrine for Future Defence Systems.** Defence platforms should adopt modular architecture with interchangeable subsystems to allow rapid upgrades, localized repairs, and obsolescence management. This doctrine should be enforced at the RFP and acquisition planning stage, especially for missile, radar, and UAV systems.
- **Establish Joint Service Simulation and Scenario Testing Labs** To support tri-service operations, India should build integrated testing facilities that simulate cyber, drone, missile, and electronic warfare conditions. These labs must link DRDO, private industry, and the Services for validating technology under combat-like conditions before deployment.
- **Bridge Academia-Industry-Forces Gap for Semiconductor and Defence Electronics.** Facilitate deep partnerships between India's top semiconductor research hubs (IITs, IISc, design houses) and defence manufacturers. Encourage joint development of critical components like GaN amplifiers, antenna arrays, and AI-based detection modules for long-term tech independence.

CONCLUSION

The MRSAM India Ecosystem Summit 2.0 turned out to be a far more nuanced concept than the operational success of a missile system as it exposed the strategic, industrial, and doctrinal inflection point at which India currently stands. At its core, the summit reflected a maturing defence ecosystem that is no longer content with transactional procurement but seeks long-term technological partnerships, joint capability development, and strategic autonomy. The discourse across panels and technical sessions pointed to a paradigm shift: from platform-centric defence planning to ecosystem-centric thinking.

Yet, even as the MRSAM program exemplifies the power of international collaboration and indigenisation, it simultaneously highlights some of the structural vulnerabilities that continue to hinder India’s defence preparedness and need to be addressed. Issues such as fragmented procurement cycles, the absence of doctrinal coherence across services, uneven training infrastructure, and the need for lifecycle management are no longer but peripheral, they are central. The summit underscored that hardware alone will not define future readiness; it is the integration of people, processes, platforms, and partnerships that will.

The evolving threat landscape, marked by swarming drones, hypersonic weapons, cyber incursions, and multi-domain warfare, demands not just technological leapfrogging but institutional recalibration. While India has achieved noteworthy milestones in co-production and missile reliability, the more enduring challenge lies in institutionalising jointness, accelerating adaptive learning, and reducing latency between innovation and deployment.

Moreover, the India–Israel partnership in MRSAM should not be seen as an end-state but as a replicable model for high-trust, high-tech strategic convergence. India must leverage this template to build future joint ventures, not only in missiles but also in space, electronic warfare, and AI-driven C4ISR systems. The lessons are unambiguous: strategic trust, shared ownership, and user-driven design are the cornerstones of effective defence innovation.

The summit closed with the realization that India’s strategic autonomy is not a product; it is a process, a cumulative outcome of policy foresight, institutional agility, and an innovation-driven defence culture. If nurtured with vision and velocity, the MR-SAM ecosystem may well serve as a lodestar for India's future trajectory in aerospace and defence self-reliance.