DISCLAIMER – VIEWS EXPRESSED ARE THOSE OF THE PRESENTER & ARE NOT ENDORSED BY ANY OFFICIAL POLICY ON THE SUBJECT BY THE GOVERNMENT IN GENERAL or DEFENCE FORCES IN PARTICULAR

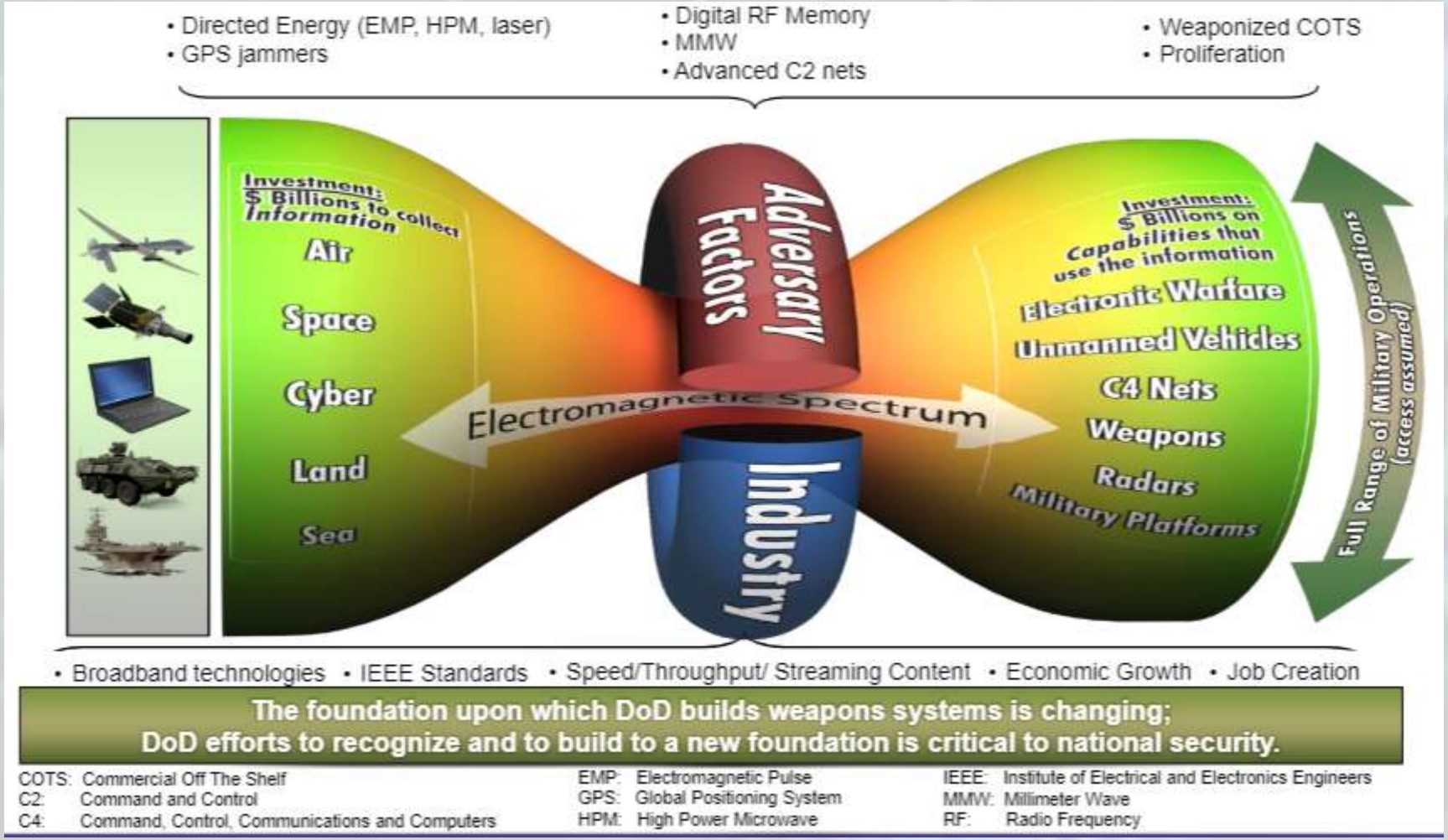
SPACE-BASED ELECTRONIC WARFARE

Speaker - Lt Col Vivek Gopal

Image Credit: https://www.emsopedia.org/entries/space-ew/

"If a man takes no thought about what is distant, he will find sorrow near at hand."

- Confucius (551 B.C. – 479 B.C)



Source: AFCEA, 2020, 'Agile EMSO' – Presentation by Rosner, Coyle et al , DISA

PRESENT CONFLICT PARADIGM

- Enlargement of the spatial dimension - Geographical indeterminacy of theatre of operations
- Transformation of the temporal element - Simultaneous multiplicity of points of interaction
- Mutation of the belligerents' identity - Obliteration of combatant/civilian categories
- Expansion of the nature of targets - Increased blending of civilian and military targets
- Systematization of asymmetrical warfare - Weaponization of civilian assets

THREAT VECTORS – MITIGATION STRATEGY

- Need to manage use of the EMS - better and more dynamically
- Need to adapt to EW-related events, either in terms of mitigating problems or taking advantage of opportunities
- Need to shift more to offense - responding to every problem defensively will never get ahead of the adversary and is bound to be unaffordable
- COST FACTOR - (1) impose monetary cost on the adversary; (2) introduce chaos and uncertainty in adversary operations; (3) create the potential for negative consequences from adversary actions

COST FACTOR INVOLVED – EW IS AN INSURANCE POLICY

- EW to be leveraged for - intelligence, surveillance and reconnaissance (ISR), command, control and communications (C3), weapon control, and positioning, navigation and timing (PNT)
- TREAT THE SPECRUM AS A MANOEUVRE SPACE - (1) range improvements; (2) increased experimentation, learning, training, and exercising in EW-degraded environments; and (3) development of higher level EW modeling, simulation, and analysis capabilities

SPACE EW – BRIEF OVERVIEW – OTHER NATIONS

	R&D	Testing	Operational	Use in Conflict
LEO Direct Ascent	🟢	🟢	🟢	🔴
MEO/GEO Direct Ascent	🟡	🟡	-	🔴
LEO Co-Orbital	🟡	?	-	🔴
MEO/GEO Co-Orbital	🟡	-	-	🔴
Directed Energy	🟢	🟡	-	🔴
Electronic Warfare	🟢	🟢	🟢	?
Space Situational Awareness	🟢	🟢	🟢	?

Legend: none 🔴 some 🟡 significant 🟢 uncertain "?" no data "-"

- *PLASSF*
- *RPO – SJ series satellites*
- *Gaofeng*
- *CASC 509 Institute & SWIEE Southwest Electronic Equipment Research Institute – Cluster for geofix of targets*

	R&D	Testing	Operational	Use in Conflict
LEO Direct Ascent	🟢	🟡	-	🔴
MEO/GEO Direct Ascent	🟡	-	-	🔴
LEO Co-Orbital	🟢	🟡	-	🔴
MEO/GEO Co-Orbital	🟡	-	-	🔴
Directed Energy	🟢	🟡	?	🔴
Electronic Warfare	🟢	🟢	🟢	🟢
Space Situational Awareness	🟢	🟢	🟢	?

Legend: none 🔴 some 🟡 significant 🟢 uncertain "?" no data "-"

Project 'Sledopyt'

- *Moskva 1 & 2*
- *Peresvet*
- *Tirada 2S*
- *Krasukha -4*
- *Bylina – KV and MM*

	R&D	Testing	Operational	Use in Conflict
LEO Direct Ascent	🟢	🟡	-	🔴
MEO/GEO Direct Ascent	-	-	-	🔴
LEO Co-Orbital	🟡	?	-	🔴
MEO/GEO Co-Orbital	🟡	?	-	🔴
Directed Energy	🟢	🟡	?	🔴
Electronic Warfare	🟢	🟢	🟢	🟢
Space Situational Awareness	🟢	🟢	🟢	🟢

Legend: none 🔴 some 🟡 significant 🟢 uncertain "?" no data "-"

- *NAVWAR program*
- *EW Counter Space System (CSS)*
- *NROL – 44 : Launched 2020 (SIGINT)*
- *AEHF -5: Secure communication links*
- *Space Delta (2) / 721st Operational Group & Maui based 15th Space Svl Sqn*

Source: Gopal, Vivek. 2021. "Space-Based-Electronic-Warfare-A-Strategic-Force-Multiplier-For-India." Synergy, December, pp 153–189, CENJOWS.

SPACE EW – DRAGON's LEAP

Doctrine/ Policy – *From 'savage power' to 'smart knowledge', From 'extreme consumption' to 'invisible penetration',* **Stigmergy -** *From 'linear confrontation' to 'non-linear game'.* (Megha Paridhi – China Tech Dispatch (https://chinatechdispatch.substack.com/p/electronic-warfare-and-evolution?s=r)

Technology – *Iridium-108 satellite HACKED by Chinese (South China Morning Post). The Ontology of Cyber Situational Awareness for Satellites (OntoCSA4Sat), a computer system jointly developed by the National University of Defence Technology in Changsha and Beijing Aerospace Control Centre, maintains a detailed database of satellites, according to the researchers.US also investing in 'Hack a Satellite' contest. (India hosts the NASA Space Challenge)*

DRO – cis-Lunar Orbit *– Chang'E 5 & 7 – Satellite Relays – Lagrange points – LASER Communication & VLBI (US also has a plan in place)*

Research in Universities Abroad - https://www.dw.com/en/chinese-military-made-in-germany-how-chinas-military-uses-knowledge-from-joint-research-with-german-universities/a-61845742

Threat to Starlink ? - *China has developed an ultra-high-powered microwave weapon that could be mounted on its satellites. This hunter-killer weapon, known as a Relativistic Klystron Amplifier (RKA)*

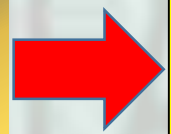
SPACE EW - WHY THE NEED ?

- Space – Militarised (Weaponised) – New 'Terrain' of Warfare
- Strategic Autonomy
- Measure of Comprehensive National Power
- Essential Part of the Techno-Geo-Strategy
- Enhance Situational Awareness
- Augment GBEWS Capability
- Safeguard Space Assets (ASATs/ Adversarial Misadventures)
- EMS Manoeuvre- Shape the Environment

'INTELLIGENCE' OBTAINED FROM

IMINT, SIGINT, MASINT Combined

Shorten the sensor to effector loop



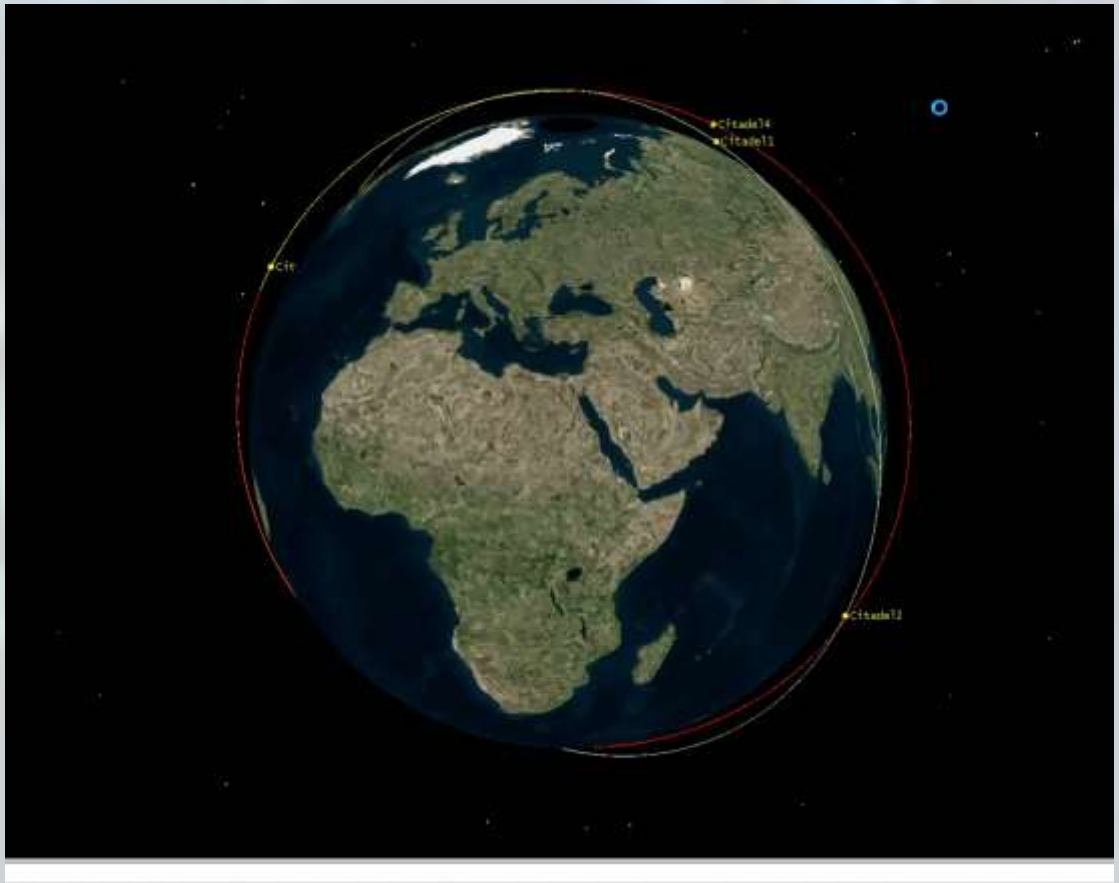
Info Provide
Info Deny
Info Deceive

Source: Gopal, Vivek. 2021. "Space-Based-Electronic-Warfare-A-Strategic-Force-Multiplier-For-India." Synergy, December, pp 153–189, CENJOWS.

HYPOTHETICAL SCENARIO

How EW in Space is a Potent Force Multiplier – Increased Situational Awareness

Lotos- S1 – ELINT Satellite (Russia) – Russianspaceweb.com



Animation Courtesy – Kepler Aerospace, Bengaluru

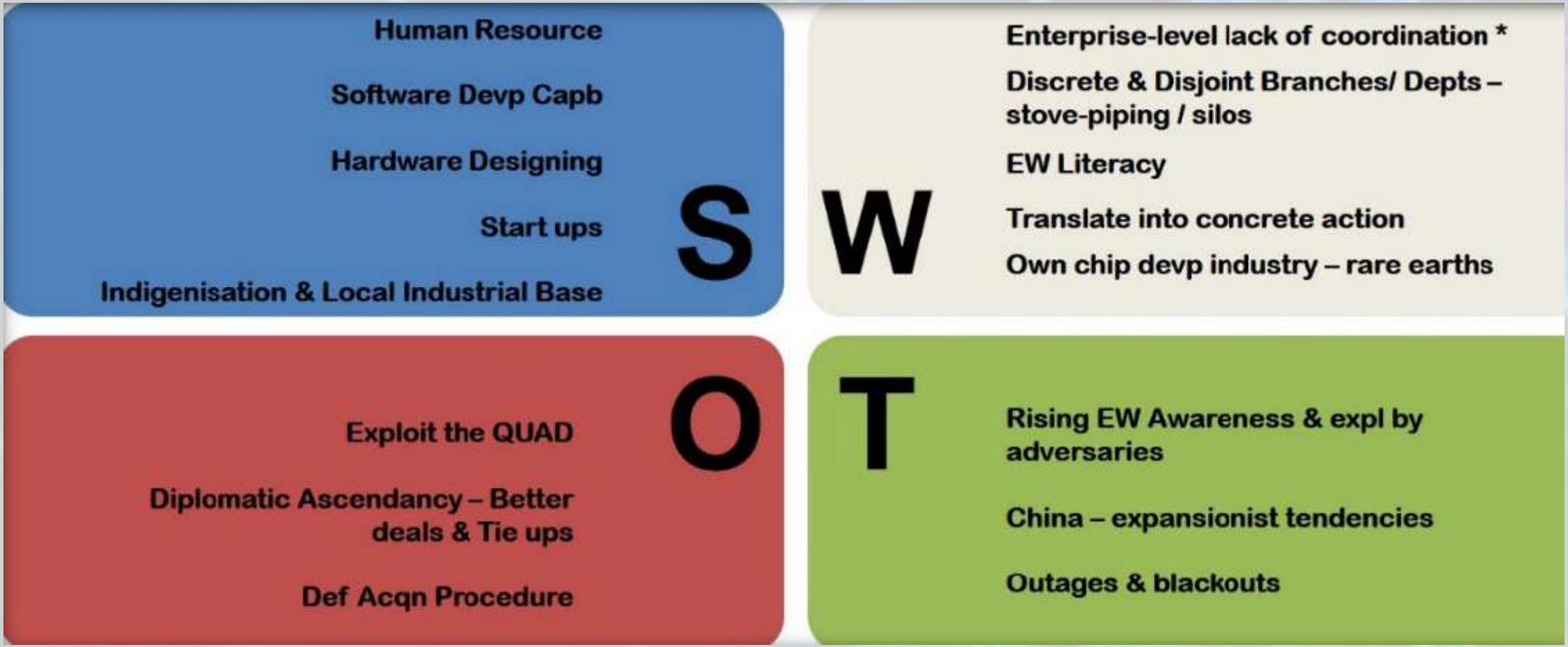
DOTMLPF - P FRAMEWORK – SPACE EW

Doctrine, Organization, Training, Material, Leadership and Education, Personnel, Facilities and Policy (DOTMLPF-P) analysis as part of the Functional Need Analysis

- Doctrine – Essential – Factor in Space & Counterspace Capabilities
- Organization – Have We Made the Difference?
- Training – From 'HERE' to 'THERE'
- Material – COTS / Space Grade / Fab & Chips/ Sensors
- Personnel – Space Force ? (Education – Academia)
- Leadership – HQ IDS (DSA) and Support by Other Verticals
- Facilities – Recycling Rate/ Start Ups/ Industry

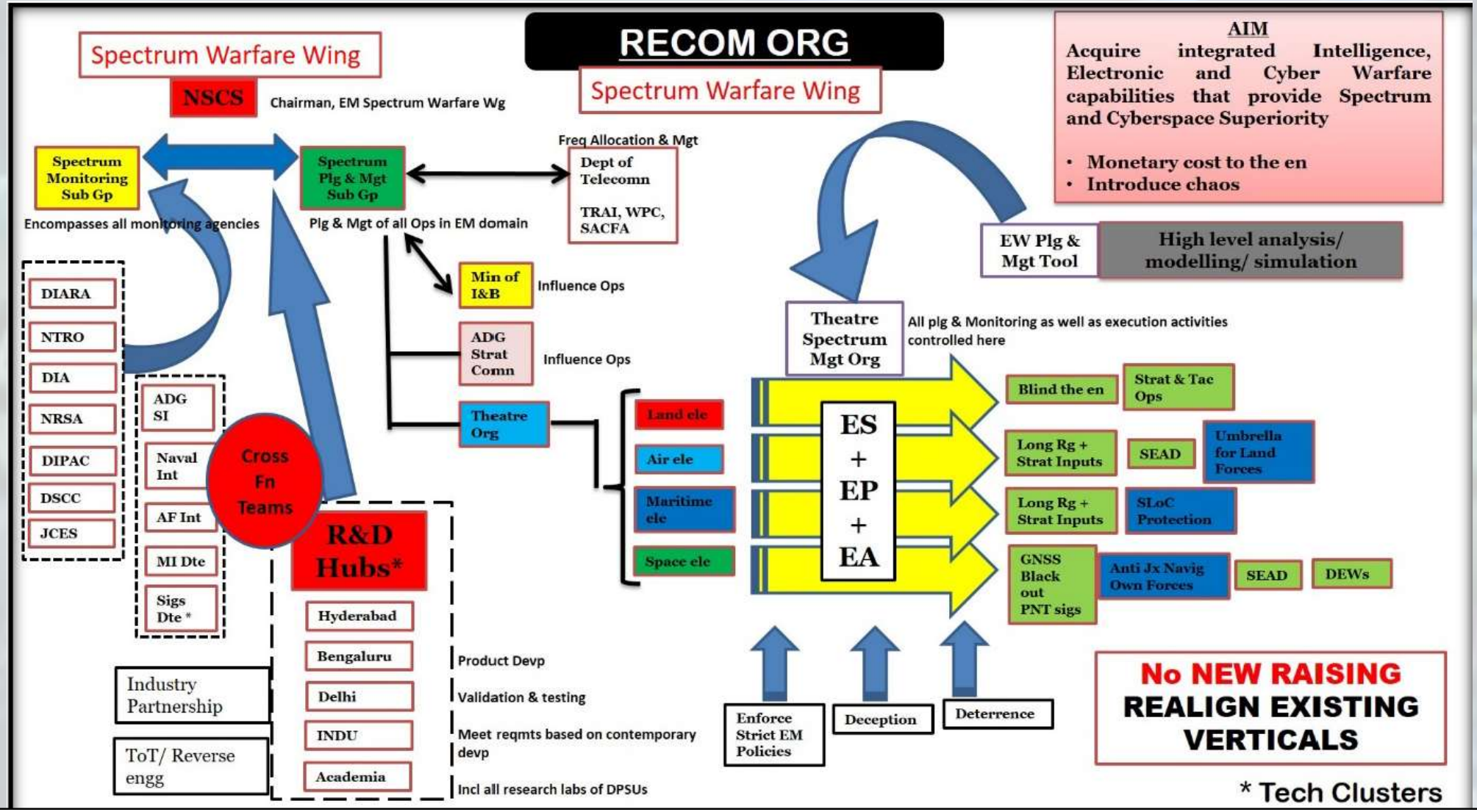
Source: Wikipedia & https://ssl.armywarcollege.edu/dde/documents/jsps/terms/DOTMLPF.cfm

SWOT ANALYSIS – PRECURSOR TO POLICY



Source: Gopal Vivek, Electronic Warfare Capability: Establishment of Spectrum Warfare Wing and Roadmap for India, Centre for Land Warfare Studies (CLAWS), Issue 295, June 2021

EW ORGANISATION – ALL ENCOMPASSING



Source: Gopal Vivek, Electronic Warfare Capability: Establishment of Spectrum Warfare Wing and Roadmap for India, Centre for Land Warfare Studies (CLAWS), Issue 295, June 2021

SUGGESTED ORG FALL OUT

- Core Capabilities Development
- Doctrine & Strategies to Evolve
- National Level - Technology Foresight - an instrument for long term anticipation that aims at supporting strategic decisions.
- Strategic Level – Technology Clusters Need to be Developed – Cross Functional Teams
- Use of Pseudosatellites/ HAPS
- Nanotechnology, 3D Printing & Cognitive EW
- Self Healing Technologies
- Tactical Level – Drills, Tactics, Techniques, Procedures

INDUSTRY PARTICIPATION

CONVERSATION LEADS TO COLLABORATION, AND COLLABORATION LEADS TO INNOVATION

- Efficient CEMA Techniques and tools for integrated EW, SIGINT, and Cyber
- Miniaturized High Gain Broadband Directional Antennas supporting both receive/transmit
- Miniaturized High Efficiency Broadband Power Amplifiers
- Low SWaP Direction Finding (DF) Antennas operating across the full band of interest
- Fast Tuning Sense, Detect, DF, and Engage Algorithms supporting Modern Waveforms
- Miniaturized Tuners/Radios/Processors that support Digitization and Processing at Sensor
- Machine Learning Technologies supporting improved responsiveness and flexibility
- C5ISR/EW Modular Open Suite of Standards (CMOSS) compatible capabilities
- Ruggedized GPU HW and algorithms to pace threat and support Micro-Service architecture
- EW Modelling, Simulation, and Visualization supporting Mission Planning and Effectiveness

ACCELERATE DEVP & DPLY OF ADVANCED TECH – SOFTWARE & HARDWARE BOTH – MODULAR SOFTWARE & EXISTING HARDWARE – REDUCE PROTOTYPING TIMELINES

SUMMING UP – ACTION POINTS

- Evolve a Doctrine & Capability Document
- Have a Well Structured Responsive, AGILE Organization
- National Level - Technology Absorption – R&D – Innovate
- Rapid Prototype Development – Utilise Expertise of DLRL, DRDO
- Enhanced role of ISpA, INSPACe, NSIL – Faster recycling, Lower Launch Costs
- Develop EWPMT, Test Ranges, Validate Forces in EW Degraded Environment
- Develop an EW Mindset – Think Outside the Box !!

TO CONCLUDE . . . . .

RETHINK – RESET – RECALIBRATE - REINVENT

Possibilities for 'CROWS'

Status Quo – The CROW is happy !!

Paradise – The CROW is ecstatic !!

Conflict – CROW is busy flapping !!

CEMA-geddon !!

THANK YOU