



DAILY EDITORIAL ANALYSIS

TOPIC

**FORWARD-DEPLOYED ENGINEERING
(FDE) & AI IN DEFENCE OPERATIONS**

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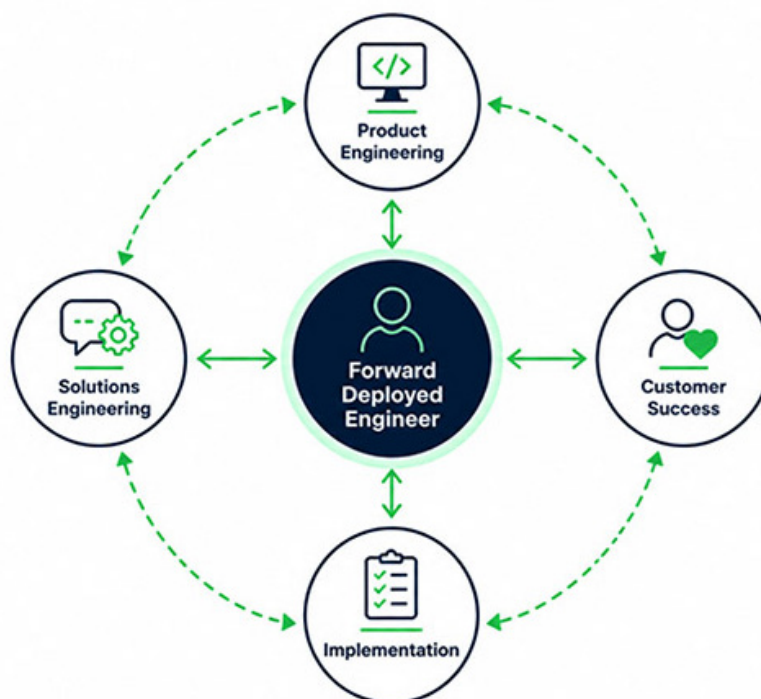
FORWARD-DEPLOYED ENGINEERING (FDE) & AI IN DEFENCE OPERATIONS

Context

- Forward-Deployed Engineering (FDE) has gained prominence as AI adoption shifts from experimentation to operational deployment, with defence and other sectors seeking engineers to adapt AI to real-world workflows.

About 'Forward-Deployed Engineering' (FDE)

- It was pioneered by **Palantir** around **2006** that **embedded software engineers with users**.
 - The engineer in FDE observes operational problems, modifies or develops software rapidly, and feeds field experience back to the core product team.
- Palantir initially paired a '**Delta**' (FDE) with an '**Echo**' (**deployment strategist**), often a former military officer/domain expert. It brought together technical expertise and institutional knowledge.
- Thus, an FDE combines three roles:
 - Engineer:** Builds and modifies software/AI solutions.
 - Product Strategist:** Converts operational requirements into technological solutions.
 - Field Operator / Technology Intermediary:** Understands how technology performs under actual conditions.



Core Characteristics of FDE

- Product Ownership:** The FDE remains an employee of the technology company and retains influence over product design.
 - Instead of creating a new system from scratch, existing capabilities can be customized for a specific military mission, reducing **costs and adoption time**.
- Bi-directional Knowledge Flow:** FDE creates a continuous bridge between developer and user. Engineers explain technological capabilities to military personnel, while users communicate failures, unforeseen situations and operational requirements back to developers.
 - It helps close the **AI capability–operational utility gap**.

- **Field-Driven Productisation:** Custom solutions developed for one client can become reusable product features.
 - ♦ Repeated field iterations therefore improve the core product and make subsequent deployments faster.

Why FDE Matters for Defence AI?

- Modern military effectiveness increasingly depends on **AI, software, cloud infrastructure, data and digital networks**.
 - ♦ However, possessing advanced technology does not automatically translate into mission success.
- Defence deployment adds classified/unclassified information, access controls, legacy databases, incompatible systems and mission-specific workflows.
- This is the **deployment gap**, the difference between what AI can theoretically do and the operational value it actually delivers.
- A **MIT study in 2025 reported that 95% of AI pilots failed to generate business value**, highlighting organisational silos and data-integration problems.
- FDE addresses this by putting technical expertise alongside operational users. It converts generic AI capability into **context-specific military capability**.

Case Study: Project Maven

- Project Maven, launched by the **US Department of Defense in 2017**, initially used machine learning to analyse the enormous volume of drone imagery and video generated during operations in **Iraq and Afghanistan**, which human analysts could not process efficiently.
- Over time, it evolved into the **Maven Smart System (MSS)**, a broader AI-enabled command-and-control platform covering **battlespace management, target management, AI-enabled deliberate planning and execution, and machine-assisted disclosure**.
- **Maven Smart System (MSS)** has **supported Ukrainian forces** during the **Russia-Ukraine war**, including AI-enabled decision support for targeting.
- MSS capabilities helped US forces strike **more than 1,000 identified targets, around 10 times the number possible without MSS** during operations in **Iran**.
- The wider lesson is that AI is becoming an additional layer between battlefield sensors i.e. **satellites, drones and personnel** and commanders, fusing information into actionable situational awareness.

Challenges & Concerns Related to FDE

- **Skill dependency:** When external FDEs leave, militaries may lack personnel capable of maintaining customised AI systems.
- **Vendor lock-in:** Close developer-user relationships can make military requirements and infrastructure dependent on one firm.
- **Cost and duration:** FDEs are expensive and should operate against defined milestones rather than indefinitely.
- **Security:** Embedded personnel must operate within stringent military data, cybersecurity and classification protocols.
- **Requirement capture:** FDEs can influence future military requirements, raising questions of institutional autonomy and procurement neutrality.

India's Effort: Supporting FDE Ecosystem

- India already possesses several building blocks: **iDEX/DIO, DRDO, Service Headquarters, Technology Development Fund (TDF), DRDO Industry-Academia Centres of Excellence, CAIR and DYSL-AI**.
- However, an explicit operational bridge between technology developers and military users remains important.
- For example, an iDEX **DISC challenge** seeks an 'AI Module for UAS for Autonomous Recognition, Identification and Targeting'.

- Developers such as **DIO, HAL or defence start-ups** could embed engineers during **user testing, pilot testing, operational experimentation and iteration** rather than ending engagement at the prototype stage.

Way Forward

- India should institutionalise FDE as a **time-bound deployment and learning mechanism**, with clear milestones, interoperability and data-security standards.
- In the long term, the **Armed Forces** should develop indigenous FDE talent by leveraging structures such as the **Army Corps of Engineers and Military Engineer Services (MES)**, alongside DRDO and technical institutions.
- The objective should be clear: not merely acquiring AI, but mastering its deployment, adaptation and sustained operational use.
- In the AI age, technological superiority will depend as much on the ability to integrate technology with soldiers and military workflows as on possessing sophisticated algorithms.

Daily Mains Practice Question

[Q] Examine the role of Forward-Deployed Engineering (FDE) in integrating AI into defence operations. Discuss its potential and challenges for India's defence ecosystem.

Source: IDSA

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