Mid-Air Booster Recovery

Why in News?

Recently, **Elon Musk's SpaceX** used a pair of **giant robotic arms** named **Mechazilla** to grab Starship's booster **Super Heavy**, mid-air after separation from the **Starship rocket.**

- This **novel approach** improves the booster's **reusability** by avoiding ocean landings and **reducing costs and turnaround time.**

What are the Key Points of the Mechazilla (Mid-Air Booster Recovery)?

- **About Mechazilla:** It refers to SpaceX's **towering structure** equipped with a pair of **giant robotic arms** designed to **catch and recover** the parts of launch vehicles during its descent.
- **Working of Mechazilla:** Once the launch vehicle separates from the booster, the booster returns to the launch site, using **grid fins** to control its **descent and orientation**.
  - As it nears the launch tower, the robotic arms, which are controlled by **precision motors and actuators**, align vertically along the tower.
- **Difference from Falcon 9 Recovery: Falcon 9** booster lands on **specially-built platforms** using **landing legs** strapped to its side, rather than being caught in mid-air.
- **Comparison with Competitors:**
  - **Rocket Lab:** It employs **helicopters** to catch boosters mid-air using parachutes.
  - **Blue Origin**: It uses its **New Shepard** rocket to **land vertically**, relying on its engines to slow descent.
  - **United Launch Alliance (ULA)**: It focuses on recovering **key engine components** instead of the entire booster. **ULA** is a **joint venture** between **Boeing and Lockheed Martin**.
  - **NASA: NASA** uses **parachutes** for rocket recovery and is experimenting with **hypersonic inflatable aerodynamic decelerators (HIAD)**.
    - HIAD consists of a **Flexible Thermal Protection System (F-TPS)** that protects the entry vehicle through **hypersonic atmospheric entry**.
- **Significance of the Mission:** The successful capture of the booster brings SpaceX closer to the goal of **reusing rockets** in **rapid succession** by eliminating costly and time-consuming processes of ocean landings or parachute-based systems.

Note:

The **Indian Space Research Organisation (ISRO)** successfully completed the third and final **Reusable Launch Vehicle Landing Experiment (RLV LEX-03)** for the **Pushpak vehicle**.

- Pushpak is **India's first uncrewed flying testbed** developed by ISRO.

What is Starship?

- **About Starship:** Starship is a **two-stage heavy lift vehicle** comprising a **booster (called Super Heavy)**, and an upper section (the Starship spacecraft).
  - It is the **largest rocket ever (120 metres)**, taller than even the **Saturn V** (111 metres), which took **Neil Armstrong** to the Moon.
- **Applications:** It is designed to carry **crew and cargo** to **Earth orbit, the Moon, Mars,** and beyond, and once fully operational, can revolutionise space travel.
- **Importance for future space Exploration:** SpaceX wants to use the **Starship HLS (Human Landing System)** to take NASA astronauts back to the moon by **2026** as a part of the **Artemis III mission**.
  - Eventually, **SpaceX** hopes that Starship will put the first humans on **Mars.**

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q.With reference to India's satellite launch vehicles, consider the following statements: (2018)

1. PSLVs launch the satellites useful for Earth resources monitoring whereas GSLVs are designed mainly to launch communication satellites.
2. Satellites launched by PSLV appear to remain permanently fixed in the same position in the sky, as viewed from a particular location on Earth.
3. GSLV Mk III is a four-staged launch vehicle with the first and third stages using solid rocket motors; and the second and fourth stages using liquid rocket engines.

Which of the statements given above is/are correct?

(a) 1 only

(b) 2 and 3

(c) 1 and 2

(d) 3 only

Ans: (a)

PDF Refernece URL: https://www.drishtiias.com/printpdf/mid-air-booster-recovery