

SPACE SWEEPERS

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Economic Impact of Medium-Sized Space Debris (5 cm – 1 m)

Debris Size	Potential Impact	Estimated Economic Damage
5–10 cm	Destruction or serious damage to small/medium satellites	€10–100 million
10–50 cm	Total destruction of medium/large satellites	€100–500 million
50 cm – 1 m	Potential orbital catastrophe (domino effect)	Up to billions of euros (including indirect losses)

PRESENT RESOLUTION

- **Collision Avoidance Maneuvers**

Active satellites perform maneuvers when warned of potential collisions (Conjunction Warnings).

Critical issue: Maneuvers are **costly**, consume fuel, shorten satellite life, and **only work if the debris is tracked**.

- **Mitigation Guidelines**

Agencies recommend best practices (e.g., passivation, end-of-life deorbiting) to prevent new debris creation.

Critical issue: These are **voluntary**, with **limited enforcement**, and do not address existing debris.

- **Early-Stage Removal Technologies**

Experimental systems (nets, harpoons, robotic arms) are under development (e.g., ESA's ClearSpace-1).

Critical issue: **No operational system** currently exists for removing debris in this size range.

ADDITIONAL SPACE TUG FUNCTION

Main Functions of Space Tugs

- **Orbit transfer** of satellites to desired altitudes
- **Satellite servicing** (life extension, adjustments)
- **Debris removal** and deorbiting
- **End-of-life disposal** to graveyard orbits
- **Precise deployment** of small satellites
- **Rescue missions** for misdelivered payloads

Market Size and Forecast

- **2024:** Estimated at **\$1.70 billion**.
- **2025:** Projected to reach **\$1.95 billion**.
- **2030:** Expected to grow to **\$3.98 billion**, with a **Compound Annual Growth Rate (CAGR)** of **15.20%** from 2024 to 2030 .