Adoption Barrier Map

Adoption Barrier Map (Problem → Failure Mode → O.R.B.I.T. Resolution)

Adoption Barrier	Why It Blocks Adoption	Evidence from Literature	O.R.B.I.T. Resolution
Single-point deployment failure	One failed burn-wire or cutter permanently disables PMD	Documented reel jams, cutter failures, one-shot mechanisms in TSS-1R, YES-2, NSTT/CSTT	Dual independent restraints + independent cutters; either path alone opens the door
Launch safety vs EOL reliability conflict	Systems must be launch-safe yet reliable years later; most designs trade one for the other	EDT payloads treated as experiments, not certifiable subsystems	Mechanical launch inhibit + independent electrical inhibit; physically separates launch safety from EOL execution
Dependence on spacecraft health	At EOL, power, avionics, and comms are most likely degraded or dead	Post-mission analyses cite avionics-dependent activation as a dominant failure mode	Internal lifeboat battery + timer/heartbeat triggers; zero dependence on host power or commands
Non-verifiable deployment states	"Command sent" ≠ "tether deployed"; regulators cannot accept assumed success	Literature notes ambiguous outcomes after release events	Door-open + spool-payout sensing; release without motion explicitly detected as a jam
Binary failure behavior	Partial failure = zero PMD benefit	Drag sails and EDTs fail catastrophically on partial deployment	O.R.B.I.T. allows degraded performance; success defined as sustained current flow, not peak force

Attachment B: Validation Roadmap

(What is already validated vs what O.R.B.I.T. must validate — and how)

Validation Scope Separation (This is critical and judge-mature)

Already validated externally (literature & missions):

- Electrodynamic braking physics

- Bare aluminum tape tether performance

- Tape tether survivability assumptions

- Deorbit timescales (months–years in 500–900 km LEO)

What O.R.B.I.T. must validate internally:

- Failure-independent deployment

- Launch safety + EOL reliability separation

- Autonomous execution with dead spacecraft

- Honest detection of deployment vs jam

Validation Roadmap (Failure-Mode Driven)

Validation Test	What It Proves	How It's Done	Adoption Risk Addressed
Dual-Path Release Test	No single irreversible failure blocks deployment	Disable Channel A → deploy via B; repeat inverse	Single-point failure
Launch Inhibit Test	Impossible to deploy during launch	Attempt firing with mechanical inhibit engaged	Launch safety
Dead-Spacecraft Test	Deployment without host power or avionics	Host disconnected; timer/heartbeat triggers deployment	Autonomy
Deployment Verification Test	System knows if deployment actually occurred	Door opens but spool locked → jam declared	Regulatory trust
Dormancy Survival Test	Years-long inactivity doesn't kill execution	Long sleep → fire cutters successfully	Long-term reliability