Small Spacecraft & Distributed Systems

Has SSDS Succeeded at Its Own Mission?

111 projects · 56% visible impact · 26 missions flown · 16 technologies commercialized

Data sources: NASA TechPort, NTRS, USASpending.gov, SEC EDGAR, SBIR.gov, public web.
Knowledge base frozen 2026-04-14 after 50 autonomous agent sessions.
Note: Public records may not reflect current project status or partnerships.

Knowledge base: SST Infusion & Transition Tracker · techport.alexandervandijk.xyz/kb/ssds-infusion/

April 2026 · Agent TechPort · Alexander van Dijk

The Question

Measuring SSDS against its own words

"The Small Spacecraft & Distributed Systems program within NASA's Space Technology Mission Directorate, expands the ability to execute unique missions through rapid development and demonstration of capabilities for small spacecraft and distributed systems applicable to exploration, science and the commercial space sector."

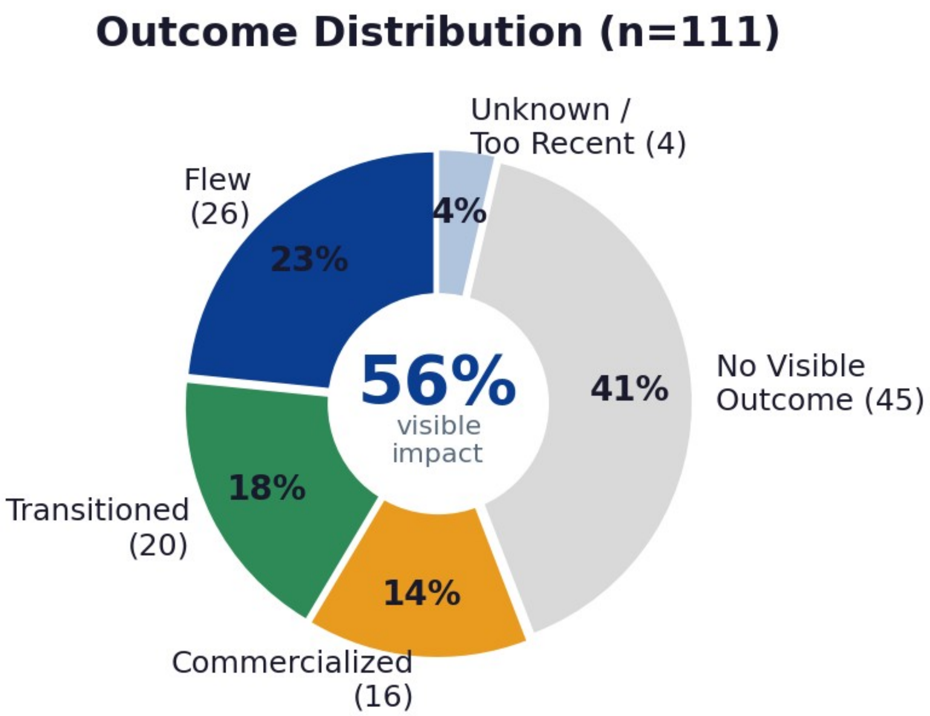
Four testable claims in one sentence:

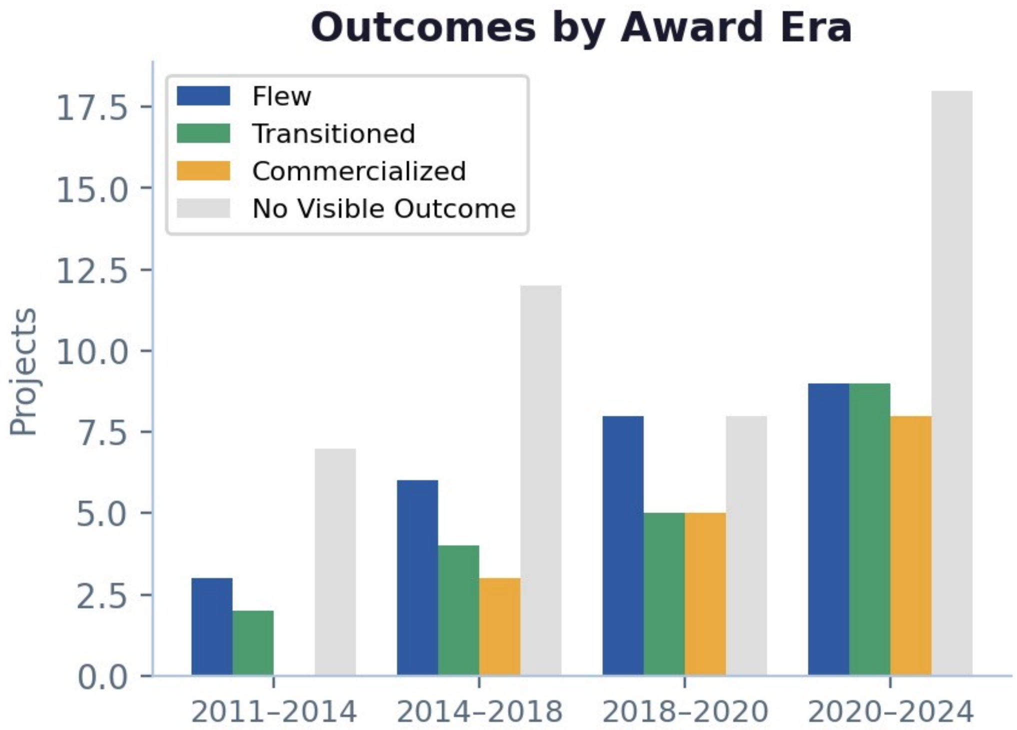
1. Unique missions	Has SSDS enabled missions that would not otherwise have flown?
2. Rapid development	How fast does SSDS technology go from award to flight?
3. Capabilities	Which technology areas succeeded — and which stalled?
4. Three sectors	Is impact distributed across exploration, science, and commercial?

Rudy's framing: "Ideally, it would tell us if we've succeeded at that — however nebulous that is."

Portfolio at a Glance

111 projects, 2011–2026 — what happened to each one?





111	56%	26	16	~40%
Total projects	Visible impact	Missions flown	Commercialized	No visible outcome

Source: SST Infusion KB portfolio tracker (111 projects, 100% investigated). TechPort snapshot 2026-04-04.

Unique Missions Enabled

Missions that would not have flown without SSDS technology

MarCO 2018

First interplanetary CubeSats (Mars, InSight relay)

CAPSTONE 2022

First CubeSat in NRHO — pathfinder for Gateway

TBIRD 2022

200 Gbps optical downlink — world record

Starling 2023

First 4-sat autonomous swarm mesh network

BIT-3 on Artemis 1

First iodine gridded ion engine in deep space

CHOMPTT: only SST project to reach TRL 9 (chip-scale atomic clock laser time transfer, U Florida)

PTD-1 HYDROS: first water electrolysis propulsion in space (Tethers Unlimited, 2021)

PhoneSat: $7K/satellite, first COTS-smartphone avionics (2013 — opened the CubeSat era)

CPOD: first autonomous CubeSat docking in orbit (Tyvak, 2022)

ACS3: largest composite-boom solar sail deployed (80 m^2, 2024)

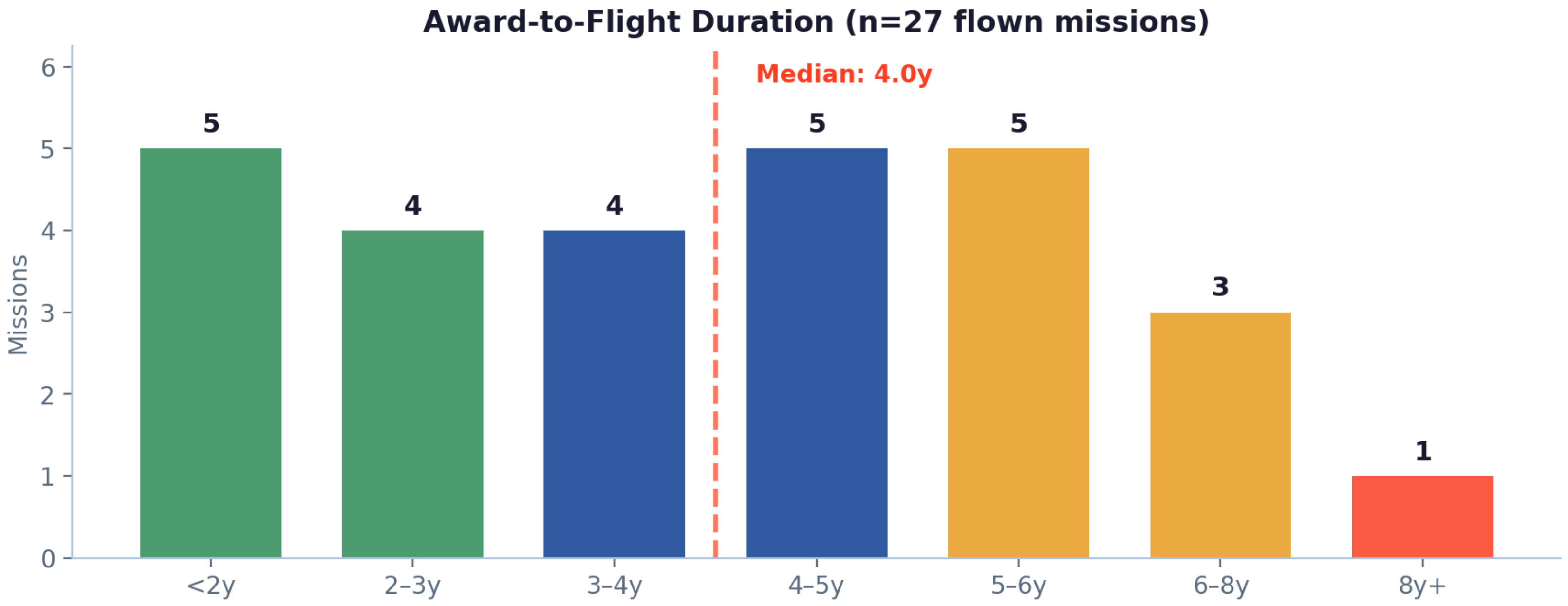
Starling 1.5: first autonomous inter-operator conjunction avoidance with SpaceX Starlink (2024–25)

Takeaway: SSDS has enabled at least 10 genuine “firsts” — missions and demonstrations that did not previously exist.

Source: SST Infusion KB overview.md, topics/high-profile-missions.md. All missions confirmed flown.

Is It Rapid?

Start-to-flight timelines for 26 SSDS missions



Fastest: R5 series

~2 years from concept to flight.
5 of 10 spacecraft flown.
JSC rapid-reaction CubeSat model.

Slowest: CPOD

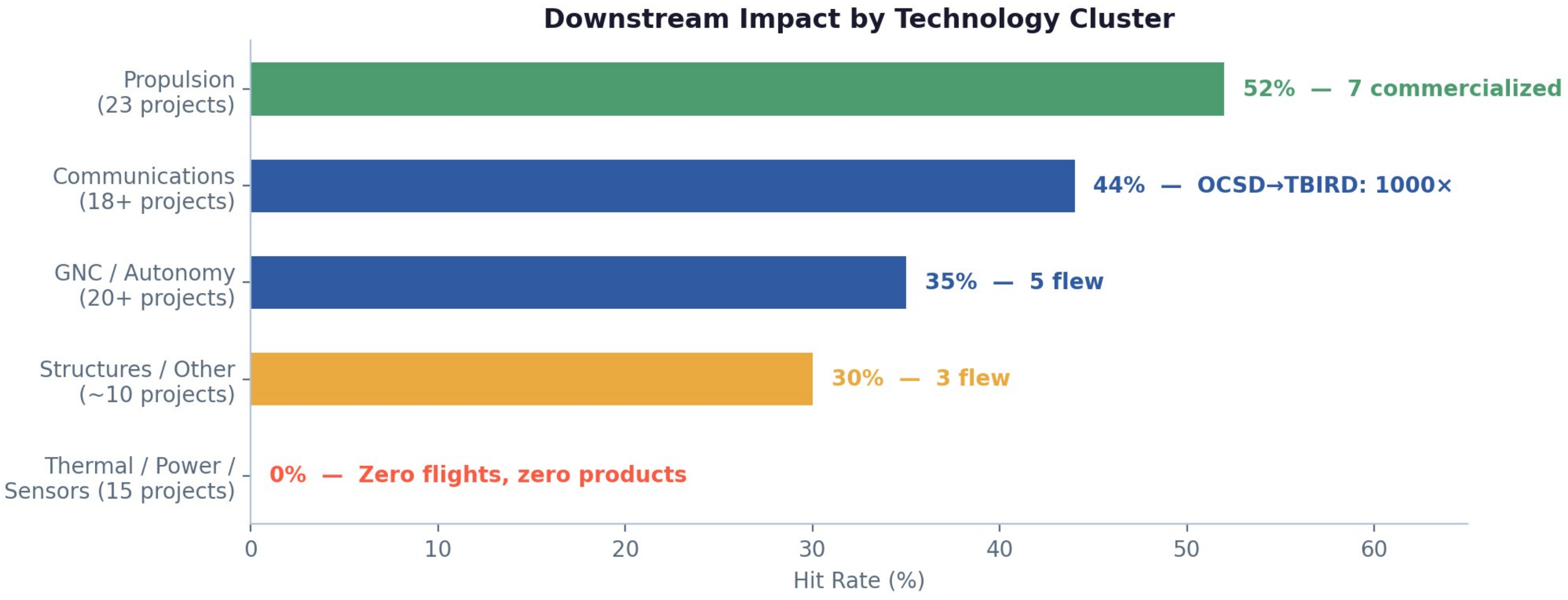
10 years (2012–2022).
First autonomous CubeSat docking.
Complex missions take longer.

Takeaway: Median award-to-flight is ~4 years. R5 proves “rapid” is achievable; most projects are standard NASA timelines.

Source: SST Infusion KB sst-portfolio-tracker.md. Dates from TechPort start date to confirmed flight date.

What Determines Success?

Technology cluster is the single strongest predictor of downstream impact



Why propulsion wins

The smallsat market needs maneuverability, and there's no legacy supplier to displace. 7 of 16 commercialized SSDS technologies are propulsion systems.

Why thermal/power fails

Overwhelmingly university-led. Universities lack flight opportunity pathways. Every project hit TRL 5–6 and stopped.

Takeaway: Subsystem type determines fate. Propulsion has a clear market; thermal/power has no flight path.

Source: SST Infusion KB overview.md (technology cluster table). Full portfolio, n=111.

The 1000× Optical Leap

From 50 Mbps to 200 Gbps in four years — same program

OCSD
2012–2018

Aerospace Corp laser downlink demo.
50 Mbps achieved.

→

ISARA
2012–2017

JPL Ka-band reflectarray.
Heritage → MarCO.

→

TBIRD/PTD-3
2019–2022

MIT LL optical terminal. 200 Gbps world record.

→

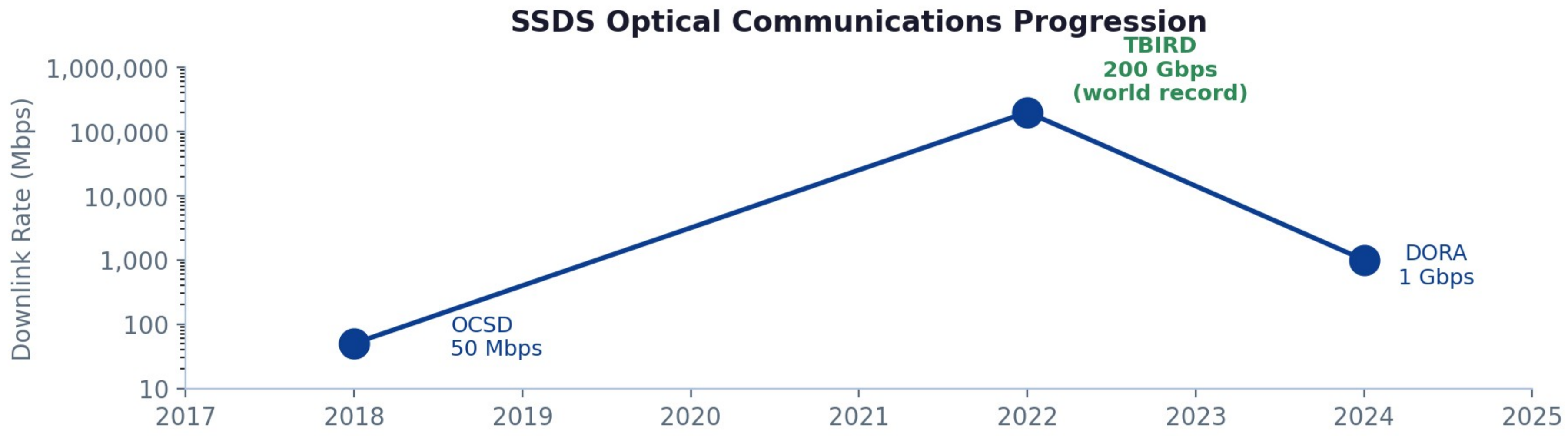
CLICK-A
2017–2022

MIT laser crosslink. First CubeSat-to-CubeSat optical.

→

DORA
2020–2024

ASU optical receiver. 1 Gbps. ISS deploy Oct 2024.



Takeaway: SSDS funded the entire optical comms progression: downlink, crosslink, and receiver. 1000× improvement in 4 years.

Source: SST Infusion KB topics/smallsat-communications.md. OCSD [11587], TBIRD [106821], CLICK [94065], DORA [106810].

People Chains: The Hidden Transfer Mechanism

12 individuals carried SSDS knowledge into 5 downstream convergence missions

Paulo Lozano

MIT → Accion Systems

Electrospray propulsion

Commercialized

Simone D'Amico

Stanford → Starling + VISORS

GNSS nav → swarm autonomy

2 convergences

Glenn Lightsey

JSC → GA Tech → Lunar Flashlight

AR&D software → deep-space

2 convergences

John Christian

JSC → GA Tech (11 yrs later)

MEMS IMU → optical nav

AAS Fellow

Siamak Hesar

BCT X-NAV → Kayhan Space

Autonomous GNC → TraCSS

Founded company

Dante Lauretta

U Arizona (SST) → OSIRIS-REx PI

ML nav → $800M flagship

Flagship mission

5 convergence missions: VISORS (4+ chains), SWARM-EX (3), GPDM (3), BeaverCube (2), LunaNet PNT stack (4)

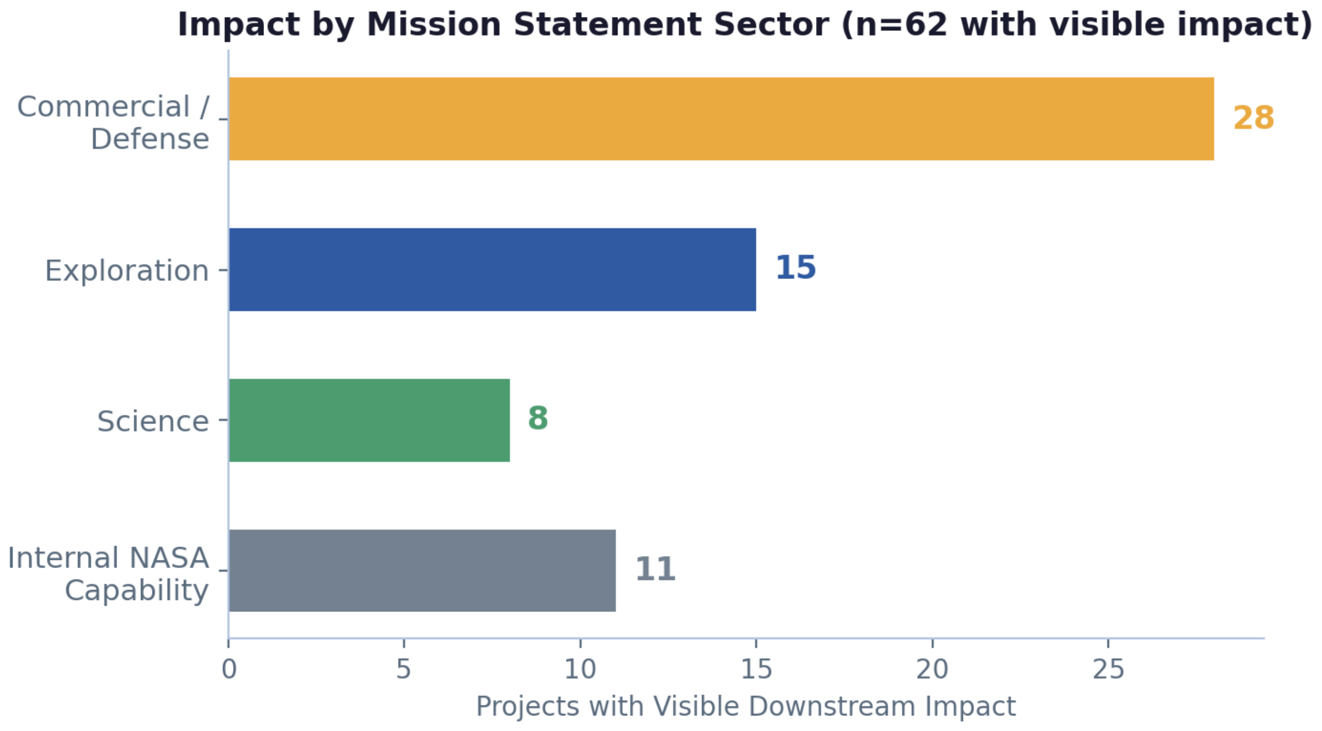
Network topology is a star: D'Amico and Lightsey each appear in 2 of 5 convergences. Most PIs do not cross-pollinate — impact flows through hub nodes.

Takeaway: People chains are SSDS's most underappreciated transfer mechanism. Projects with modest TRL gains still produce outsized impact through the researchers they develop.

Source: SST Infusion KB archetypes.md (#4 People Chain), overview.md. 12 confirmed individuals, 5 convergence missions.

Exploration • Science • Commercial

Where did SSDS impact actually land?



Sector breakdown

Commercial/Defense: 16 commercialized products, 5 company acquisitions ($3B+), SDA constellation production (134+ sats), Andromeda IDIQ (3 direct SST winners)

Exploration: CAPSTONE (Gateway pathfinder), MarCO (Mars relay), BIT-3 (Artemis 1), RadPC (Moon), LunaNet PNT stack (4 projects), LASSO (DARPA cislunar)

Science: Starling (swarm autonomy science), CHOMPTT (TRL 9 timing), ARKSAT-1 (ISS deploy), VISORS convergence (NSF distributed telescope)

Internal NASA: ARC swarm arc (4 missions, 10 years), JSC→GA Tech talent pipeline, GRC EP test infrastructure, MSFC propulsion continuity

Takeaway: Commercial/defense outcomes dominate. Exploration is the strongest NASA-internal sector. Pure science is the thinnest.

Source: SST Infusion KB overview.md. Sector by downstream impact destination. Projects serving multiple sectors counted once by primary impact.

“Smallsats Will Be the Norm, Not the Exception”

Evidence that SSDS is achieving Rudy’s vision

5 of ~15 SSDS-funded companies changed ownership (33%)

2020	Blue Canyon → Raytheon/RTX	**~$350M**	Starling buses, DARPA Blackjack
2020	Tethers Unlimited → ARKA	**undisclosed**	HYDROS water propulsion
2021	Accion (51%) → Tracker Capital	**$42M round**	TILE electrospray
2024	Tyvak/Terran Orbital → Lockheed Martin	**$385M**	134+ SDA satellites
2025	ExoTerra → Voyager Technologies	**undisclosed**	21 SDA T1 modules
2025	ARKA (incl. TUI) → CACI	**$2.6B**	Serial acquisition cascade

Defense program capture: SSDS alumni are structurally load-bearing

Space Force Andromeda IDIQ ($1.84B, 2026): 3 of 14 winners have direct SSDS lineage; 7 of 14 have broader STMD connections

SDA Tranche 0/1: Tyvak (134+ satellite buses), ExoTerra (21 propulsion modules), BCT (DARPA Blackjack heritage)

MDA SHIELD: 3 SST-heritage propulsion companies (Busek, Accion, Turion) hold initial orders on the same missile defense vehicle

Takeaway: SSDS technology is embedded in Space Force and MDA procurement at scale. Smallsats are becoming the norm.

Source: SST Infusion KB archetypes.md (#1, #17, #18), surprises/defense-prime-acquisition-pattern.md. Verified via USASpending + press.

The Honest Gaps

What the data says about where SSDS has not succeeded

~40% No Visible Outcome

45 of 111 projects have no traceable downstream impact

17 academic TRL ceilings: university thermal/power projects consistently reach TRL 5–6 and stall

14 NASA center dead ends: internal projects that closed without follow-on

5 terminated: PTD-2 (I&T mishap), Aerojet green prop, NG reaction sphere, X-NAV (canceled), X-NAV autonomy

1 launch failure: EDSN (Super Strypi, 2015)

Missions That Struggled

Lunar Flashlight: ASCENT green propellant failure (3D-printed manifold obstruction). 61 NTRS papers — still the most-published SST project

iSat: Iodine Hall thruster at MSFC. 11 NTRS papers but never flew. 10-year institutional investment without flight demo

EDSN: 8-CubeSat swarm lost in Super Strypi launch failure. ARC rebuilt from spares → Nodes

DORA: Optical receiver deployed from ISS Oct 2024 but only 56-day orbital lifetime (solar activity)

Structural Questions

Universities produce zero direct commercializations — they transition at 2.4× the company rate but never reach market alone

Defense-prime acquisition pattern: all 3 PTD commercial partners acquired within 4 years. Success or leakage?

Thermal/power/sensors: 0% flight rate across 15 projects. Is the portfolio balance right?

Science sector is the thinnest downstream outcome category

Takeaway: ~40% no-outcome rate is normal for R&D — but concentration in thermal/power and universities suggests structural failure.

Source: SST Infusion KB dead_ends/catalog.md, overview.md, topics/thermal-power-sensors.md.

What’s Still Flying

Active missions and near-term pipeline

CLICK-B/C
MIT laser crosslinks

NET Q2 2026

GPDM
Green Propulsion Dual Mode (MSFC)

Slipped; ~2026

SSPICY
Starfish Space debris inspection

Late 2026

R5-S3/S5/S9
JSC rapid-reaction CubeSats

2026

VISORS
NSF distributed telescope (4+ SST chains)

2026+

SWARM-EX
NSF swarm (3 SST chains)

Dec 2026 (ELaNa 59)

SCOPE-1
UT Austin crater-based lunar nav

~2027

LASSO
First DARPA partnership (cislunar)

Phase 1A (abstracts May 2026)

MRV
NG satellite servicing (NGHT-1X thruster)

2026 launch, 3 customers

Already on orbit: DUPLEX (ISS deploy Dec 2025, dual propulsion testing), DiskSat (4 sats, 2 commercial licenses), Otter Pup 2 (Starfish, partner TBD), R5-S10 (RPO with Momentus, Mar 2026)

Source: SST Infusion KB overview.md (monitored active missions table, session 38). Status as of April 2026.

Mission Statement Scorecard

Claim-by-claim assessment

“Expands the ability to execute unique missions”

10+ genuine “firsts”: MarCO (interplanetary CubeSats), CAPSTONE (NRHO), Starling (autonomous swarm), TBIRD (200 Gbps), CHOMPTT (TRL 9), BIT-3 (Artemis 1)

CONFIRMED

“Through rapid development and demonstration”

Median award-to-flight: ~4 years. R5 achieves ~2 years. CPOD took 10. “Rapid” is achievable but not the norm.

MIXED

“Of capabilities for small spacecraft and distributed systems”

Propulsion: 52% hit rate, 7 commercialized. Comms: 1000× optical leap. Distributed systems: Starling, PY4, CLICK, SSPICY. Thermal/power: zero flights.

PARTIAL

“Applicable to exploration, science and the commercial space sector”

Commercial/defense dominates (16 products, 5 acquisitions, $3B+). Exploration strong (CAPSTONE, Artemis, RadPC, LunaNet). Science thin.

LOPSIDED

Takeaway: SSDS has clearly expanded unique mission capability. Speed and sector balance are the areas for honest scrutiny.

Source: SST Infusion KB (50 sessions, 111 projects, 172 linkages). All claims traceable to specific KB pages.

Open Questions

What the data can’t answer

Is the academic TRL ceiling fixable?

University thermal/power projects consistently stall at TRL 5. Would a structured industry bridge (co-funded with SBIR/STTR Phase III) change the outcome?

Does the defense-prime acquisition pattern serve NASA’s interests?

SST-matured tech ends up behind defense-prime walls. Does NASA retain access? Do the original PIs stay? Or does public investment subsidize private capture?

How many “no visible outcome” projects produced invisible outcomes?

Student training, unpublished know-how, negative results that steered other programs. The ~40% rate may overcount true dead ends.

What’s the right portfolio balance?

Propulsion hits 52%, thermal hits 0%. Should SSDS over-weight propulsion, or does the portfolio need frontier bets in thermal/power even if most fail?

Can the SSEP/NGHT-1X model be replicated?

Defense-prime co-development without startup risk. Only n=1 in SSDS. Is this the most capital-efficient path to impact?

Source: SST Infusion KB overview.md (Open Questions section).

About This Analysis

Built by Agent TechPort

Autonomous research agent: 50 sessions of systematic investigation

111 projects investigated (100% coverage), 51 organization pages, 172 confirmed linkages

18 maturation archetypes identified, 7 surprises flagged, 44 dead ends cataloged

Multi-source: TechPort API + NTRS (500K+ citations) + USASpending + SEC EDGAR + SBIR.gov + public web

Every claim independently verified with sample size, query, counter-query, and confidence tag

Published Knowledge Base

techport.alexandervandijk.xyz/kb/ssds-infusion/

Note: The program was renamed from “Small Spacecraft Technology” (SST) to “Small Spacecraft & Distributed Systems” (SSDS) during the KB build. The agent reconciled this from a 2025 NTRS paper (20250009467) and NASA ARC web pages before TechPort was updated — TechPort still tags all 111 projects as program=“SST.”

Data sources & limitations

TechPort records may not reflect current project status or partnerships

NTRS was unavailable for 11 of 50 sessions (restored session 38)

Outcome categories are the agent’s assessment, not NASA’s official classification

“No visible outcome” may undercount invisible outcomes (training, tacit knowledge, negative results)

Defense downstream traced via public records only; classified programs not visible

Agent TechPort

techport.alexandervandijk.xyz

Analysis based on NASA’s public TechPort database. Project records may not reflect current status, partnerships, or outcomes.