BLACK WIDOW · Research Program

Open Research Infrastructure for Validation of Autonomous Robotic Systems

PROGRAM AT A GLANCE

Module	Purpose	Current Status
Mission OS — web-based platform for autonomous mission planning	Mission control, telemetry, test logs	TRL 2–3 → target TRL 4 (Phase I)
BW-C45 — research flight carrier	Integrated testbed for aerodynamics and module separation	85 parts printed · dry assembly in progress · PDR □ → integration (Phase I)
FlyScout — compact autonomous platform for detailed inspection	Experimental module for ground and aerial inspection	Concept → prototype (Phase I)
EPM — electromagnetic module retention and release system	Deployment mechanism without continuous current	Lab prototype → n≥50 tests (Phase I)
ALBATROSS — flight energy-efficiency research module	Extended range through energy savings	Simulation + paired flights (Phase I)
OWL — low-signature (low-noise) flight research	Reduced acoustic footprint	Ground measurements → flyby (Phase I)
Digital Twin — system digital twin (XFOIL/JSBSim/SITL)	Gate check before field trials (M1 GO/NO-GO)	Modelling pipeline → M1 report (Phase I)
GNSS-denied navigation	VIO/SLAM for GPS-denied conditions	Simulation (Phase I) → hardware bench (Phase II)
Shared infrastructure (WP01)	Laboratory, IT, metrology, test rigs	Team co-investment □ → full laboratory (Phase I)

TRL is assessed separately for each research track. Program-level TRL is the aggregated Phase I exit result, not the level of a single module.

WHY NOW

Autonomous robotic platforms are advancing rapidly.
Grant programmes (Horizon Europe, BRAVE1) and universities increasingly require **measurable evidence**, not simulation results alone.
Separate R&D projects rarely undergo **joint experimental validation** on a single carrier.
Funders struggle to determine which technologies actually work together.
The BLACK WIDOW team has completed the co-investment stage (CAD, dry assembly, PDR).
The next step — integration and field validation — requires external funding **now**, while infrastructure and the team are ready for Phase I.

1. Problem

Autonomous robotic platforms for surveillance, inspection, and field research are advancing quickly.
Most ideas remain at the simulation or laboratory prototype stage.
There is no systematic validation.
Individual modules — navigation, energy efficiency, payload separation, multi-platform control — rarely undergo **joint experimental validation** on a single carrier.
Consequence: high risk for grant bodies, universities, and partners.
It is difficult to answer which technologies truly work together, not only “on paper”.

2. Why existing approaches are insufficient

Approach	Limitation
Separate R&D projects per technology	No integrated testbed; results hard to compare
Commercial turnkey platforms	Closed architecture; not suited to research hypothesis validation
Simulation / Digital Twin only	TRL does not increase without ground and field data
“Whole system at once” development	Opaque budget; difficult to fund in stages

Conclusion: an **open research infrastructure** is required.
Each hypothesis must have a measurable protocol and report — not a “demonstrator without evidence”.

3. Why a research programme is needed

Grant committees, universities, and industrial partners expect:

- **Reproducible test protocols** and statistics (n, CI, GO/NO-GO)
- **Staged funding** with clearly defined expected outputs
- **Partnership**, not procurement of a “black box”
- **TRL transition 2–3 → 4–5** with documented limitations

An integrated research programme is needed, not a set of incompatible standalone projects.

WHY BLACK WIDOW

The team has completed co-investment: CAD, demonstrator dry assembly, PDR.
This reduces Phase I technical risk — we are not starting from zero.
The programme is built as **open research infrastructure**: protocols, experimental datasets, statistics, GO/NO-GO gates.
It is not a commercial product or a “black box”.
One laboratory carrier (BW-C45) and a shared platform (Mission OS) allow multiple hypotheses to be tested on a single testbed.
Results are comparable and reproducible.
Funding is staged: each stage has expected outputs for grant reporting.
Partners see progress and can pause or expand the programme.

4. Core concept

BLACK WIDOW is a unified research ecosystem for validating promising autonomous robotic platform technologies.
Phase I validates seven research technologies on the BW-C45 flight carrier:
Components:

- **Mission OS** — web-based platform for autonomous mission planning and telemetry
- **FlyScout** — compact autonomous platform for detailed inspection
- **EPM** — electromagnetic module retention and release system
- **OWL** — low-signature flight research
- **ALBATROSS** — flight energy-efficiency research module
- **GNSS-denied navigation** — VIO/SLAM for degraded or absent GPS signal conditions
- **Digital Twin** — system digital twin; modelling pipeline and gate check before flights

The **BW-C45 carrier** is the shared flight platform for all seven technologies (not counted as a separate technology).
Partner outcome: **measurable reports, experimental datasets, protocols** — not a presentation alone.

5. Programme structure

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↓
Mission OS (mission control, telemetry, logs)
↓
BW-C45 (laboratory carrier / demonstrator)
↓
Mission OS · FlyScout · EPM · OWL · ALBATROSS · GNSS · Digital Twin (7 Phase I technologies)
↓
Validation (ground + field protocols)
↓
Research results (reports, data, Phase II readiness)

All modules are tested on **shared infrastructure (WP01)** with unified programme management (WP09).

What we are requesting

Package	Amount	Duration
Phase I (standard)	$84,000	24 months
Turnkey (recommended)	$96,667	~30 months

Staged funding details — in **BW_TURNKEY_BUDGET RC3 EN**, §1.1 · 45 UAH/USD.

What the partner receives

Value	Description
Experimental results	Protocols, raw data, statistics — not PDF alone
Access to the research programme	Transparent milestones, Mission OS logs, Digital Twin
Joint research	Co-leadership / consortium opportunity (Horizon Europe, MITACS, university)
Joint publications	Material for papers on OWL, ALBATROSS, EPM tracks
Intellectual property	Under separate agreements (MOU); documentation ready for IP registration
Next stages	Phase II (GNSS/VIO, airborne EPM), extended R&D centre package $152,222

We are not selling a field-ready product.
We offer **research partnership with a measurable outcome**.

Programme modules (brief)

BW-C45 · research flight carrier

Why: flight research testbed for aerodynamics and module separation.

Output: 85 parts printed (100% canonical print scope); dry structural assembly in progress; flight-ready integration — Phase I.
Why it matters: without the carrier, remaining technologies cannot be validated on one testbed.

EPM · electromagnetic separation system

Why: module retention and release without continuous current (IEEE reference).
Output: n≥50 successful separation tests with protocol.
Why it matters: key deployment mechanism for field research.

FlyScout · detailed inspection platform

Why: compact autonomous platform — ground and aerial inspection.
Output: experimental module integrated with BW-C45.
Why it matters: mission without a separate heavy carrier.

ALBATROSS + OWL

ALBATROSS: range through energy savings — simulation estimate + paired flights.
OWL: reduced acoustic signature — ground measurements → flyby validation.
Together: longer and less detectable flight — with documented limitations.

Mission OS · web-based mission control platform

Why: one operator — multiple robotic platforms.
Output: up to 5 platforms from one station; ≥10 logged test operations.
Why it matters: programme scale-up and protocol reproducibility.

GNSS-denied navigation

Why: flight without GPS (EW, radio silence).
Output: VIO/SLAM in simulation (Phase I) → hardware (Phase II, NASA JPL reference).
Why it matters: relevant research field; hardware only after Phase I completion.

For the grant committee

Question	Answer
What will be measured?	Separation rate (EPM), flight logs, acoustic profiles (OWL), energy metrics (ALBATROSS), Mission OS operations, SITL vs flight delta (Digital Twin)
What will be published?	Material for peer-reviewed papers on OWL, ALBATROSS, EPM; protocol methodology
Expected outputs?	7 branch reports + master + technical sources; M1 GO/NO-GO; validation reports
How is success defined?	GO/NO-GO gates (M1, M6–M9, Phase I completion); KPIs §8 Budget RC3 EN
What evidence?	Protocols, experimental datasets, statistics (n, CI), as-built documentation

For the investor

Question	Answer
Why fund now?	Team co-investment complete; CAD and PDR ready; period between PDR and integration — lowest entry risk
Why is risk controlled?	Staged funding; GO/NO-GO gates; 10% reserve; Phase II reserve — trigger-based only
What reduces risk?	Digital Twin M1 before flights; n≥50 ground EPM tests; supervised flights only
Why staged?	Stage 1 ($15,111) — laboratory; then carrier, then full Phase I — no unit-cost revision
What remains after Phase I?	Laboratory, integrated demonstrator, 7 branch reports, datasets, IP documentation pack, GO/NO-GO for Phase II

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Research · Simulation · Field Validation