

ABSTRACT

Crush Depth is a third-year company competing in the 2026 MATE ROV World Championship. Headquartered at Clovis Community College, our club is one of the largest in the district. Our ROV, GKAlloy, named for our late advisor Gurinder Khaira, was designed this year with the utmost modularity, reliability, and efficiency in mind across its thruster, manipulator, and chassis systems. GKAlloy was designed for research in habitats that require collecting samples for observation, and to be able to work on offshore wind/oil platforms. To avoid damaging the environment during launches, GKAlloy is equipped with several safety features, including thruster covers, bolt covers, gear shrouding, and snipped zip ties. To assist our ROV in completing mission tasks, we created a pressure sensor for data, manipulators for specific mission tasks, and 6-degrees of freedom, enabling precise maneuverability and allowing the system to complete mission tasks efficiently and reliably.

THEME

Remotely Operated Vehicles are essential for maintaining and monitoring a range of environments. They are the leading tool for researchers seeking to advance their projects through real-time data, ecological mapping, and tracking systems. This year, the missions reflect 4 global issues that are central to global marine sustainability and the UN Sustainable Development Goals: reporting invasive species, tracking icebergs, reading offshore platform maps, and gathering environmental DNA (eDNA) sensor frequencies.

ROVs have expanded access to deep and hazardous underwater environments, enabling researchers to conduct biodiversity assessments, collect samples, and gather ecological data with greater efficiency and safety. They are widely used for imaging surveys, mapping offshore structures, and monitoring marine habitats, providing detailed information that supports more effective ecosystem evaluation and management. In recent years, with significantly changing water temperatures and constant human sea travel, invasive species have found it incredibly easy to adapt to a multitude of environments, spiking the need for monitoring and tracking of these groups.

A significant example of this would be the Huntsman Marine Science Center, which utilized Deep Trekker's PIVOT ROV to monitor invasive colonies of Didemnum vexillum, otherwise known as "sea vomit". By using the ROV to conduct underwater and offshore infrastructure inspections, researchers were able to document colony growth in areas that would otherwise be challenging and dangerous to access. This research illustrates how ROV technology expands marine biodiversity monitoring capabilities while supporting conservation efforts connected to the United Nations Sustainable Development Goal 14: Life Below Water, which focuses on protecting marine ecosystems and reducing the impacts of pollution and invasive species.



MOSAIC team preparing the ROV named "The Beast" for its first dive by Lianna Nixon.

and biological parameters throughout all seasons across different surface and sea-ice types. Using ROVs provides access to under-ice environments that are not usually available utilizing traditional methods. Studying very thin, newly formed ice, and open and refreezing land was not possible without this new technology. Direct measurements of sea ice like drilling or ice-coring can leave drastic changes to the environment and are no longer necessary for research with the implementation of ROVs. These long term field observations are necessary to improve our understanding of Arctic sea-ice and will help advance predicting Arctic climate change.

In addition to observing invasive species and under-ice ecosystems, ROV technology is also being incorporated into renewable energy research projects concentrated on marine biodiversity and sustainable infrastructure. The BeWild project (Biodiversity Enhanced Wind Farm development, Integrated monitoring & inspection and Localized Design) demonstrates how advanced monitoring technologies can make offshore wind projects environmentally sustainable. The goal for their project was to explore the balance between ecological protection and offshore wind farm expansion. Their use of ROVs focuses on integrated



Digital rendering of the BeWild Project and their use of ROVs and USVs by Fugro

monitoring and inspection. ROVs inspect turbine foundations, cables, underwater structures, and surrounding habitats. Their sensors are utilized to detect species presence, water quality, biodiversity changes, and ecological impacts near offshore structures. These applications reflect environmental, social, and governance (ESG) priorities, environmental stewardship through habitat monitoring, social value through public-good research, and governance through compliance with offshore-wind regulatory frameworks.

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CRUSH DEPTH

Clovis Community College - Fresno, CA, USA
Planting Seeds that Forever Grow Minds

DESIGN RATIONALE



GKAlloy was designed with two primary goals: to build a high-performing competition ROV and to create a professional, industry-style environment where first- and second-year students could rapidly develop technical, leadership, and communication skills.

Before the season began, Crush Depth established a unified design philosophy to ensure consistency and strong collaboration across all teams. Every design was expected to meet five core principles: Function: Parts must reliably achieve their intended purpose without failure or deformation. Form: Clean, lightweight, and visually polished designs reflected the team's attention to detail and pride in workmanship. Maintainability: Systems were designed to be easy to assemble, repair, and improve using modular designs and standardized hardware such as M3 and M5 fasteners. Manufacturability: As a small community college team with limited machining resources, Crush Depth relied heavily on in-house design work, 3D printing, sponsor-supported materials, and local machining partners for specialized components. Safety: Designs accounted for user interaction, structural stress, pinch points, and sharp edges to ensure safe operation for both users and the environment. The team also restructured its technical leadership system. Instead of broad departments, Crush Depth created smaller, specialized sub-teams to improve communication, collaboration, and accountability across the organization. This structure helped distribute responsibilities more effectively while supporting the team's continued growth. To reinforce a strong engineering culture, every sub-team maintained detailed engineering journals throughout the season. These journals documented testing, design decisions, and technical data, allowing future members or outside viewers to understand, replicate, and build upon the team's work.

CHASSIS

The chassis was built around a clear acrylic tube housing the electronics, with most structural components 3D-printed in-house for rapid prototyping and low-cost iteration. Redesigned chassis rings can now be removed independently, with integrated retaining features preventing lost hardware. Engineering simulations strengthened weak points, while flow simulations optimized thruster placement and hydrodynamic performance before physical testing confirmed the final design.

Unlocked Chassis Ring



Thruster

PROPULSION

Flow simulations guided the final eight-thruster layout, providing full six-degree-of-freedom control for precise, stable underwater movement. Power distribution was a major constraint, requiring careful balancing between thrusters, manipulators, and electronics to prevent overload while maintaining performance. Limited housing space drove component arrangement decisions prioritizing efficiency, water flow, and serviceability. Pre-existing mounting hardware simplified assembly and maintenance.

ELECTRICAL

The electrical system uses three dedicated layers for reliability and easier maintenance.

The top layer houses logic and control (Raspberry Pi, sensors, cameras). The middle layer handles power distribution, with a 48V supply feeding buck converters that balance loads across thrusters, manipulators, and electronics. The bottom layer contains ESCs, arranged for cooling and serviceability. Power and signal wiring were separated to reduce interference.



Electrical System

SURFACE SIDE

A custom GUI that lets the pilot monitor and operate the vehicle across Windows, Linux, and macOS. Includes improved performance and memory efficiency over alternatives. Live camera feeds stream from the ROV and display via OpenCV and Qt. Embedded photogrammetry tools that enable 3D reconstruction within the same application.

CONTROL SYSTEMS

The ROV is controlled using two Xbox controllers connected to a laptop on the surface. The laptop talks to a small computer inside the ROV, which sends commands to eight thrusters, a gripper, and a rotating tool. If the connection ever cuts out, the ROV automatically stops within a quarter-second to keep it safe. Built-in features like auto-leveling and speed limits make the vehicle easier to control, and our mission-planning tool, P.O.P.P.A., helps us figure out the fastest order to complete competition tasks.

HOUSING

Crush Depth selected a 152.4-mm acrylic tube as the ROV's waterproof enclosure after comparing concepts for cost, durability, and repairability. To address previous electronics sagging that damaged seals, the team developed the "Titanfall Battery" (TFB)—a modular, server-rack-inspired drawer system separating motor controllers, power, and logic boards across three layers. Housing length increased from 304.8 mm to 381mm to accommodate the new layout.

MANIPULATORS

The manipulator team began with a two-degree-of-freedom claw inspired by past competitions, ultimately selecting a four-bar linkage parallel gripper for its simplicity, reliability, and adaptability. Two refinements expanded its capability: circular cutouts to secure cylindrical PVC objects, and a hook-like opening enabling rope manipulation without full closure. This rope feature proved especially valuable for Task 2.5, connecting a sensor to the Holyrood observatory.

Manipulator

COMPANY INFORMATION



CRUSH DEPTH team by Irery Huerta

Chassis Adrian Macais (Mech. Engineering), Angel Avalos (Civil Engineering), Domer Macarine (Mech. Engineering)
Control Systems Aiden Lu (Elec. Engineering), Cecilia Urbieta (Comp. Engineering)
Electrical Michael Dulcich (Mech. Engineering), Brent Murray (Mech. Engineering), Jhan Padua (Mech. Engineering)
Finance Enrick Manansala (Aero. Engineering), Jeremy Cortez (Bio. Engineering)
Pilot Daniel Larralde (Mech. Engineering), Kevin Yazon (Mech. Engineering)
Marketing Jacob Schmidke (Psychology), Lourdes Chavez (Communication)

Mentors Gurinder Khaira, Ben Bohan
Chiefs Luke Salazar (CEO/CDO, Mech. Engineering), Jack Jackson (CEO/CDO, Mech. Engineering), Santino Gonzales (CFO, Aero. Engineering), Julia Taylor (CSO, Mech. Engineering) Emily Brereton (CMO, Philosophy)
Float Cruz Babb (Mech./Aero. Engineering)
Housing Isaac Perry (Civil Engineering), Gavin Kiggins (Mech. Engineering), Tun La Min (Aero. Engineering), Kevin Yazon (Mech Engineering)
Manipulators Austin Bethel (Mech./Aero. Engineering), Kendall Reagan (Mech. Engineering), Reagan Feystrom (Mech./Aero. Engineering), Lincoln Smith (Mech. Engineering), Sameeha Suliman (Bioengineering)
Pilot Daniel Larralde (Mech. Engineering), Kevin Yazon (Mech Engineering)
SAS Ethan Betner (Aero. Engineering)
Surface Side Tyler Barbery (Chem. Engineering), Colby Carrier (Mech Engineering), Justin Lu (Elec. Engineering)

Not pictured: Zachary Davidson (Control Systems, Elec. Engineering), Rene Espinoza (Electrical Engineering), Aden Gamber (Housing, Mechanical Engineering), Addison Hickey (Float, Mechanical Engineering), Jimmy Howell (Control Systems, Electrical), Zar Jalhayan (Control Systems, Elec. Engineering), Alex Martinez (Surface Side, Comp Engineering), Andres Martinez (Float, Comp. Engineering, Sophia Morales (Marketing, Business), Justus Pettit (Float, Comp. Science), Grayson Pressutti (Float, Mech. Engineering), Ella Siadto (Surface Side, Comp. Science), Timothy Sokoloff (SAS, Electrical Engineering), Jazmin Villagran (Control Systems, Electrical Engineering), Carson Yee (Manipulators, Mech. Engineering & Business)

COMPANY EVALUATION

During operations and ROV+FLOAT development, we treat every season as a structured opportunity for technical growth and **intellectual development**. Before any design is finalized, sub-teams produce formal trade study reports built on the Analytic Hierarchy Process, defining objectives, weighting criteria through pairwise comparison, and validating decisions with sensitivity analysis. Every member maintains an engineering journal documenting tests, design decisions, and raw data, creating a knowledge base that outlives any single year. This approach turns first- and second-year engineering, marketing, and pre-law students into engineers and communicators who can defend their work with evidence.

Crush Depth runs as a 48-person company organized into nine interdisciplinary sub-teams, all coordinated through weekly all-hands meetings, one-on-ones, and a structured Discord workspace with dedicated channels for every sub-team. Before the 2026 season, the CDO and CTO restructured the leadership system, replacing broad departments with smaller, specialized sub-teams led by Technical Leads. This change distributed accountability across more members and structurally forced cross-team integration; chassis decisions ripple through electrical, control system requirements feed propulsion, and housing constraints shape manipulator design. **Teamwork/Collaboration** is built into the company's structure, not left to chance.

Building GKAlloy required Crush Depth to operate like a startup. Our CFO and finance team developed a category-based budget early in the season, then tracked every dollar against it using a live Budget vs. Actual sheet that informs real-time spending decisions. The finance team, led by our CFO, secured funding through targeted outreach to the Associated Student Government of Clovis Community College, CCC MESA, the State Center Community College Foundation, and corporate sponsors including Forward Advantage Foundation, Culture Fresno, and Seasats. Beyond grants, the team organized fundraisers including the Bass Lake Triathlon and a Professor Walk Event, and ran a GoFundMe campaign that raised over \$3,000. This combined effort closed a \$19,000+ funding gap and made the trip to Newfoundland possible. In combination with financial acquisitions, our fundraisers were heavily promoted and pushed to multiple outlets by our marketing team led by our CMO. Crush Depth used **entrepreneurship** at its core to make our ROV + FLOAT build and travel to Newfoundland a reality. Our team not only attended several events to table and present informational work, but also hosted a major engineering showcase titled Beyond The Blueprint, an event that brought students together to showcase their engineering projects and technical work to potential sponsors and local business representatives. The event gave students the opportunity to present their designs, demonstrate projects in action, and gain experience communicating technical concepts in a professional setting. It also helped strengthen relationships between student engineering programs and industry partners within the local community.

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