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Challenge the World: New Era of International Learning



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For most of the last decade, 'internationalisation' in higher education has meant a fairly narrow set of instruments: the semester abroad, the dual degree, the summer school. Challenge-Based Learning (CBL) research now points to a different, less examined instrument — the international student competition — and makes a case that it may be the more powerful one.

In their 2025 synthesis of the CBL literature, Kenan Dikilitaş, Tim Marshall and Masoumeh Shahverdi set out both the mechanics of CBL and a growing body of evidence for what it does to students who go through it. Read closely, that evidence amounts to an argument: the more authentic and external the audience judging a student's work, the more the learning compounds. An international competition — a foreign jury, an unfamiliar country, a result with no institutional cushioning — is that authenticity taken to its logical extreme, and the case for it rests on the research in the Cover Story.

Happy reading!



Global Competitions as the New Frontier of International Education

Global Competitions as the New Frontier of International Education. What Challenge-Based Learning research tells us about why the world's testing tanks, wind tunnels and yacht clubs are becoming as important to a student's education as any lecture theatre.



The Architecture of Challenge-Based Learning

CBL traces its lineage to Apple's 'Classrooms of Tomorrow – Today' (ACOT2) project of 2008, and has since been simplified – notably through its adoption across the European Consortium of Innovative Universities (ECIU) – into three interlocking phases: Engage, Investigate and Act. The phases are not strictly sequential. Dikilitaş, Marshall and Shahverdi are explicit that each phase contains its own mini-investigation cycles, and that the three are 'closely interwoven' rather than a one-way pipeline – a team can, and often must, return to Investigate after a supposedly final solution turns out to raise new questions.

Team formation: the first design decision

CBL scholarship treats team composition as a deliberate design choice, not an administrative afterthought. Citing the foundational Challenge Based Learning guides of Nichols and colleagues, the authors recommend teams of four to five, assembled across a wide range of criteria – educational background, nationality, gender, age, and prior experience – on the reasoning that diversity widens the pool of perspectives available for problem-solving. Because roles inside a CBL team are deliberately fluid rather than fixed, a small multidisciplinary team can rotate members through research, design, communication and leadership functions as the challenge evolves, which is harder to do in large or homogeneous groups. The literature also weighs the trade-offs of how teams are formed: student-selected teams offer



ownership but risk narrowing diversity to people who already know each other; teacher-assigned teams are more balanced but retain a more traditional hierarchy; and ice-breaker-based random formation sits between the two, building early collaboration skills through shared, low-stakes tasks.

From a Big Idea to an actionable challenge

The Engage phase moves a team from a broad, often UN-Sustainable-Development-Goal-aligned 'Big Idea' – climate change, water, health, transport, democracy – toward a single actionable challenge, via a deliberately unhurried process of essential questioning. Teams generate many candidate questions before narrowing to one that is personally resonant and societally relevant, then convert it into a challenge phrased with a verb – increase, improve, reduce. Too broad a challenge becomes unmanageable; too narrow one limits how much skill a team can develop – a balance the authors note is easier to strike when the challenge is externally set by a real 'challenge provider' with a genuine stake in the outcome, rather than invented for the classroom.



Investigation: guiding questions, guiding resources

The Investigate phase converts the essential question into guiding questions, then guiding activities — stakeholder interviews, data collection, SWOT analysis, fishbone diagrams — allocated across the team by strength. The authors call this frequently the most demanding phase, since it is where a team moves from the conceptual comfort of Engage into the friction of real research: interviews generate follow-up questions, assumptions turn out to be wrong, and teams must revisit their own resources. The Challenge Institute's guidance, cited in the chapter, is blunt about the discipline this requires — cross-check questions with practitioners, use a wide span of sources, interrogate one's own assumptions, and stay willing to revisit conclusions rather than defend a pre-formed solution.

Act: solutions built for a real verdict

In the Act phase, teams narrow multiple candidate solutions to one, often using structured tools such as Edward de Bono's Six Thinking Hats — a technique that maps neatly onto a five-person CBL team, each member briefly occupying a different lens (process, facts, feelings, creativity, benefits, caution) before the group converges. The chosen solution must then be pressure-tested against evidence, not instinct, and — critically for the argument this article is building toward — presented to a genuinely authentic audience: an external stakeholder qualified to judge it on its merits, not a sympathetic instructor.

Disseminating findings to both local and wider audiences helps students feel motivated, recognised, and empowered.

Loohuis & Chapel (2021), cited in Dikilitas, Marshall & Shahverdi (2025)

What the Evidence Says: Engagement and Motivation

The second half of the chapter reviews what happens to students who go through this cycle, organised around five outcome dimensions — engagement, motivation, communication, collaboration and teamwork — each backed by a growing empirical literature rather than pedagogical intuition alone.

On engagement, Fredricks, Blumenfeld and Paris's influential three-part model — behavioural, emotional and cognitive engagement — provides the frame most CBL researchers use. Chanin et al. (2018) and Yoorubsuk and Maneewan (2022) find students engage more deeply when a task requires them to fold in their own experience, which is precisely what CBL's student-driven challenge selection is designed to do. Simón-Chico et al. (2023) link CBL to stronger behavioural engagement — listening, persistence, sustained participation — which Reeve et al. (2004) had already identified as a predictor of learning achievement, though the same authors caution that overly rigid challenge design or excessive scaffolding can blunt the autonomy that makes CBL work in the first place.

Motivation research leans on Ryan's (1995) Self-Determination Theory, which identifies autonomy, relatedness and competence as the three psychological needs underlying intrinsic motivation. Doulougeri, Vermunt, Bombaerts, Bots and De Lange (2021) map CBL's structure directly onto these needs: real decision-making builds autonomy, sustained contact with external stakeholders builds relatedness, and solving a genuinely open-ended problem builds competence. López-Fernández et al. (2020), studying Master's students in the European Space Agency's Concurrent Engineering Challenge, found CBL boosted both intrinsic and extrinsic motivation and improved the teacher-student relationship. The evidence is not uniform, however: Simón-Chico et al. (2023), working in physical education, found no discernible shift in motivation at all — a divergence the literature attributes to how differently CBL can be implemented across disciplines, rather than to any flaw in the framework itself.

Communication, Collaboration and the Discipline of Teamwork

CBL scholarship treats communication and collaboration mainly as an internal team skill — how well five students coordinate with each other. But when a CBL team's Act phase is an international competition, that skill acquires a second, much larger audience: peers from a dozen other countries, competing at the same level, at the same age. This is where a more diffuse but arguably more consequential outcome shows up — not team skill alone, but what international-education researchers increasingly call global quotient: the combined knowledge, skills, attitudes and values needed to work across cultural lines.

Global Competence

The OECD's PISA global competence framework (2018) defines this quotient in four parts — knowledge of global issues, the cognitive skill to weigh differing perspectives, openness and respect as attitudes, and values oriented toward shared human dignity. Zhang and Zhou's (2019) meta-analysis of intercultural-competence interventions finds that what actually builds this quotient is sustained, structured, task-focused contact with people from other cultures — not passive exposure to a new place. A competition supplies exactly that structure: months of shared technical preparation, then days working alongside, and being judged against, student teams from Germany, Egypt, Poland or Canada on a shared, unforgiving brief. The distinction matters: Salisbury, An and Pascarella (2013) found that simply spending a semester abroad does not reliably predict intercultural-competence gains once prior disposition is controlled for — presence in another country is not, by itself, sufficient. Sheppard, Dominick and Aronson (2004), writing on engineering education specifically, make the sharper point: what prepares students for a 'new business paradigm of international teamwork and global orientation' is structured practice actually working across borders on a shared technical problem, exactly what a submarine, catamaran or wind-turbine jury demands.

Global competitions are Challenge-Based Learning (CBL) in its most authentic, rigorous, and transformative form, supplying, autonomy, relatedness, and competence through real challenges, global peers, and authentic audiences"

Meeting the global peer group

There is a subtler effect the literature on career and graduate-study aspiration keeps circling back to. Standing next to a Dutch or Canadian engineering student who is exactly one's own age, working the same wind-tunnel schedule, competing on genuinely equal terms, recalibrates a student's sense of where they stand globally in a way a lecture on 'global careers' cannot. Independent research compiled by NAFSA, including the IIE/AIFS Foundation's Passport to Leadership study (2026) and a 2025 analysis of the earnings impact of education-abroad participation, links this kind of exposure to higher rates of postgraduate study abroad, stronger interest in international employers, and higher early-career earnings. K-GEO's own observation across three competition cycles tracks with that research: students who return from Monaco, the UK or the Netherlands come back with a noticeably sharper sense of which international Master's programmes they want to apply to and which global organisations they would consider working for — aspiration that is vague before the trip and concrete afterward.

None of this displaces the narrower, team-level findings in the CBL literature — Gudonienė et al. (2021) on structured communication practice, Harris and Kloubec (2014) on front-loaded role and conflict training, Mesutoglu et al. (2022) on the real friction multidisciplinary teams still work through. Those remain the foundation a team needs before it boards a flight. But the evidence suggests this foundation is necessary, not sufficient: the step-change in global quotient and career aspiration comes from the international contact itself, not merely from the teamwork skills that make that contact possible.

The Argument: Competitions as the Purest Act Phase

Put the evidence together and a pattern emerges. CBL's gains are strongest precisely where the framework is implemented most faithfully — real stakeholders, real evidence-based iteration, and, above all, a genuinely authentic audience for the final Act phase. A classroom presentation to a visiting industry partner satisfies that requirement in a limited way. An international student competition — a foreign, specialist jury with no institutional relationship to the student, entrants from a dozen other countries, a public and unhedged result — satisfies it about as completely as an undergraduate education can arrange. It supplies Ryan's three motivational needs in concentrated form: real autonomy over a real design, relatedness forged under shared pressure in an unfamiliar country, and competence judged by people who owe the student no courtesy. It forces the communication scaffolding Harris and Kloubec argue for, because there is no other way to brief a jury, a scuba pilot, or a fellow competitor from another continent. And it is, almost by definition, the 'authentic audience' that Loohuis and Chapel identify as the difference between a challenge that motivates and one that merely occupies time.

This is the intellectual case for treating global competitions as core international-education infrastructure rather than a co-curricular extra: they are not a departure from Challenge-Based Learning, but its most rigorous, highest-stakes expression.

How It Looks in Practice, at Kumaraguru College of Technology

KCT runs this argument as lived practice rather than theory. In the first ten days of July 2026 alone, three student teams carried KCT-built CBL challenges to their Act phase abroad:

Team Sea Sakthi took an indigenously engineered electric catamaran, Yali 5.0, to the 13th Monaco Energy Boat Challenge, where it won the Prince Albert II of Monaco Foundation Sustainability Award as the sole Indian entrant among 56 teams from 22 countries.

Team InCraft took India's first student-built, human-powered submarine to the European International Submarine Races in the United Kingdom and became the first Indian team to win the IMarEST Sustainability Award, against seventeen university teams from nine countries.

Team Sulal took a small wind turbine to the International Small Wind Turbine Contest hosted by Hanze University of Applied Sciences in the Netherlands, with testing in TU Delft's Open Jet Facility, finishing runner-up for the Sustainability Award.

Each team was built the way the research recommends — small, multidisciplinary, drawing engineering students alongside those from liberal arts and business programmes — and each treated its foreign jury not as a formality but as the genuine test of a challenge worked through over multiple competition cycles.

K-GEO's role across all three has been to convert that CBL cycle into a travel-ready one: brokering mentoring and sponsor relationships, arranging logistics thousands of kilometres from Coimbatore, and building the standing institutional ties — with the Yacht Club de Monaco, with UK marine-engineering bodies, with Dutch wind-energy researchers — that make this a repeatable pipeline, not a one-off trip. It is, in miniature, exactly what the CBL literature describes: a student-owned challenge, iterated honestly, and finally handed to an audience with no reason to be kind about it.

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Innovation-Driven Design and Experimental Validation of Nitrile Rubber-Coated Nylon 6,6 Soft Actuator for Marine Robot Buoyancy Systems

Marine robots are increasingly deployed for underwater exploration, infrastructure inspection, environmental monitoring, and defense applications. Their operation in uncertain underwater environments necessitates reliable emergency recovery mechanisms capable of restoring positive buoyancy during system failures. This work presents an innovation-driven design methodology for developing a flexible inflatable buoyancy actuator using Nitrile Butadiene Rubber (NBR)-coated Nylon 6,6 fabric reinforced composite. Unlike conventional rigid buoyancy systems, the proposed soft actuator integrates lightweight textile composites, elastomeric coatings, and optimized fabrication techniques to improve reliability, structural integrity, and deployment efficiency.

The actuator was fabricated through a hand lay-up process followed by vacuum bag molding and autoclave vulcanization to maximize matrix–reinforcement adhesion. Experimental validation was performed using ASTM D412, ISO 37:2011, ASTM D3786, DIN 53887, and IS 11056 standards to evaluate tensile strength, air permeability, and bursting resistance. The developed material exhibited a tensile strength of 49.148 MPa, sustained a peak load of 1.4 kN, demonstrated zero air permeability, and withstood pressures exceeding 68.67 bar without rupture. These results confirm the suitability of the proposed design for emergency buoyancy applications in remotely operated and autonomous underwater vehicles. The study demonstrates how material innovation, design optimization, and engineering validation collectively contribute toward safer, lightweight, and reliable marine robotic systems.

Keywords: Marine Robotics, Innovation Engineering, Soft Robotics, Design Engineering, Textile Composites, Buoyancy Control System, NBR Coating, Nylon 6,6.

Introduction

Marine robots have become indispensable tools for underwater exploration owing to their ability to operate in environments inaccessible to humans. Autonomous Underwater Vehicles (AUVs) and Remotely Operated Vehicles (ROVs) perform inspection, oceanographic surveys, offshore infrastructure monitoring, and defense missions. However, increasing operating depth significantly elevates hydrostatic pressure while simultaneously reducing opportunities for manual intervention during system failures. Consequently, the development of reliable emergency buoyancy systems has become a critical design requirement for next-generation underwater robots.

Traditional buoyancy mechanisms employ rigid pressure vessels or ballast tanks that increase system complexity, structural weight, manufacturing cost, and energy consumption. From a design engineering perspective, these limitations motivate the transition toward compliant soft robotic actuators capable of producing controlled volume variation with minimal mechanical complexity.

Textile-reinforced elastomeric composites offer an attractive solution by combining flexibility, high strength-to-weight ratio, excellent sealing capability, and manufacturability into a compact architecture. The present work adopts an innovation-centric design philosophy where material selection, structural architecture, and manufacturing methodology are simultaneously optimized to develop an inflatable emergency buoyancy actuator capable of operating under high external pressure while maintaining mechanical reliability.

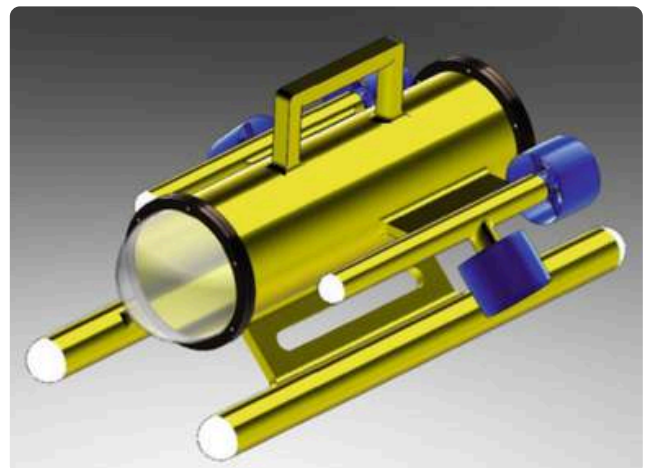


Figure 1: Depicting an ROV (Remotely Operated Vehicle)

Innovation in Design Engineering

The primary innovation lies in replacing conventional rigid buoyancy devices with a fabric-reinforced soft actuator engineered specifically for underwater deployment. Rather than treating the bladder merely as a pressure vessel, the proposed design integrates materials engineering, composite manufacturing, and structural optimization into a unified engineering solution.

The innovation framework comprises four key elements:

- **Material Innovation:** Plain woven Nylon 6,6 was selected for its excellent elongation characteristics, lightweight nature, and durability. A Nitrile Butadiene Rubber coating enhances elasticity, gas impermeability, oil resistance, and tear strength, enabling reliable inflation under extreme pressure conditions.
- **Structural Innovation:** A flexible composite architecture incorporating stainless-steel mesh reinforcement increases load transfer capability while preserving compliance required for volumetric expansion.
- **Manufacturing Innovation:** Hand lay-up fabrication combined with vacuum bag molding and autoclave curing improves interfacial bonding between reinforcement and elastomer, thereby minimizing delamination and improving mechanical consistency.
- **Functional Innovation:** Instead of continuous actuation, the inflatable bladder functions as an emergency recovery mechanism, providing rapid buoyancy restoration whenever propulsion or control failure occurs.

This integrated design methodology demonstrates how innovation extends beyond material development to encompass system functionality, manufacturability, reliability, and operational safety.

Engineering Design Methodology

The actuator was designed by considering three fundamental engineering requirements:

- *High tensile strength to withstand inflation loading.*
- *Complete air retention to maintain buoyancy.*
- *High bursting resistance under hydrostatic pressure.*

These requirements directly governed material selection and manufacturing parameters. Nylon 6,6 served as the reinforcing substrate owing to its superior elongation characteristics, while NBR coating sealed fabric porosity and introduced elastic recovery. Stainless-steel mesh further enhanced structural stability by distributing stresses during inflation.

Fabrication involved mould preparation, abrasive treatment of the metallic reinforcement, sequential layering of coated fabric, manual coating thickness control, vacuum bag molding, and autoclave vulcanization at 160 °C. Adhesive systems (Chemlock 205 and 220) ensured strong matrix-reinforcement bonding, which plays a decisive role in preventing interfacial failure during high-pressure operation.

Experimental Validation

Design validation was conducted through standardized mechanical characterization procedures.

Tensile Testing

Mechanical strength was evaluated using ASTM D412 and ISO 37:2011. Dumbbell specimens with a gauge length of 50 mm exhibited hyperelastic deformation prior to failure, characteristic of elastomeric composites. The developed material achieved a maximum tensile strength of 49.148 MPa while sustaining 1.4 kN peak load, demonstrating adequate structural integrity for repeated inflation cycles.



Figure 2: Tensile testing on NBR coated Nylon 66 fabric-reinforced composite

Air Permeability

Air retention is fundamental to buoyancy generation. Testing performed according to IS 11056 and DIN 53887 demonstrated 0 LPH air leakage, confirming that the NBR coating effectively sealed the woven textile structure and eliminated leakage pathways. This result validates the actuator's ability to maintain inflation during underwater deployment.

Bursting Performance

Burst resistance was evaluated following ASTM D3786 and ISO 13938 standards. The actuator successfully tolerated pressures exceeding 68.67 bar, reaching the maximum capacity of the testing equipment without rupture. Inflation produced a hemispherical geometry, which inherently minimizes stress concentration and enhances pressure distribution throughout the structure.



Figure 3: Hemispherical shape obtained from burst test

Design Engineering Implications

The experimental investigation demonstrates that the proposed actuator satisfies the essential design objectives for underwater emergency buoyancy systems.

- *From an engineering perspective, the innovation offers several advantages:*
- *Reduced system weight through textile composite construction.*
- *Improved packaging efficiency because the actuator remains compact before deployment.*
- *Enhanced reliability through complete air sealing and exceptional burst resistance.*
- *Simplified manufacturing using scalable composite fabrication techniques.*
- *Increased operational safety by enabling emergency recovery without additional propulsion systems.*

The hemispherical inflation profile further improves structural efficiency by minimizing localized stresses while maximizing displaced volume. Such characteristics make the actuator equally applicable to emergency recovery systems and active buoyancy control mechanisms integrated with closed-loop control algorithms for future autonomous marine robots.

Conclusion

This study demonstrates the successful integration of innovation and design engineering principles in developing a soft inflatable buoyancy actuator for marine robots. Through optimized material selection, composite architecture, and manufacturing methodology, a high-performance NBR-coated Nylon 6,6 actuator was realized and experimentally validated. The developed actuator achieved 49.148 MPa tensile strength, 1.4 kN peak load capacity, zero air permeability, and resistance beyond 68.67 bar, confirming its suitability for underwater emergency buoyancy applications. Beyond material characterization, the work establishes a systematic engineering framework for designing lightweight, reliable, and manufacturable soft robotic systems capable of enhancing the safety and operational reliability of future underwater vehicles. The design philosophy presented herein provides a foundation for next-generation intelligent buoyancy systems employing adaptive control, smart materials, and advanced soft robotic architectures for autonomous marine exploration.

Northern Illinois University (NIU): Where Chicagoland Industry meets Next-Generation Engineering Talents

Northern Illinois University (NIU) is a public Carnegie R2 research university located in DeKalb, Illinois, with additional campuses and centers in Chicago, Naperville, and Rockford. Founded in 1895, NIU is home to more than 16,000 students, including over 12,000 undergraduates, and offers 174 academic programs across seven colleges. With a 14:1 student-to-faculty ratio and an average undergraduate class size of just 23 students, the university combines the resources of a major research institution with the personalized attention of a smaller university. NIU welcomes students from more than 70 countries, with international students coming predominantly from India, China, South Korea, Saudi Arabia, and Nigeria, creating a diverse global learning community.

Located just 65 miles (105 km) west of Chicago, the city of DeKalb has a population of approximately 40,000 and offers the ideal balance of a welcoming college-town atmosphere and easy access to one of the United States' largest manufacturing and technology hubs. The surrounding Chicagoland region is home to numerous Fortune 500 companies, advanced manufacturing firms, and engineering enterprises, providing students with abundant internship, research, and employment opportunities.

NIU is nationally recognized by the Wall Street Journal and CollegeNET for advancing social mobility, reflecting its commitment to providing high-quality education that creates meaningful career outcomes. The university is also recognized as a Carnegie R2 High Research Activity institution, with research strengths spanning advanced manufacturing, engineering, robotics, cybersecurity, data analytics, materials science, health sciences, education, and environmental sustainability. Through specialized research centers and strong collaborations with industry, students have opportunities to work on applied research that addresses real-world technological and societal challenges.



Northern Illinois University (NIU): Where Chicagoland Industry meets Next-Generation Engineering Talents



NIU's College of Engineering and Engineering Technology (CEET) sits at the heart of this vibrant industrial ecosystem, giving students continuous exposure to authentic engineering challenges. That connection comes alive through NIU's Senior Design Program, the capstone experience for CEET's graduating seniors. Multidisciplinary teams spanning mechanical, electrical, industrial, mechatronics, and biomedical engineering partner directly with sponsoring companies to solve genuine engineering problems. Guided by faculty and industry mentors, students research, prototype, and test innovative solutions before presenting their work each spring at the Senior Design Showcase, an event that now attracts more than 1,000 attendees.

Kumaraguru College of Technology (KCT) has been an active partner in this experiential learning pipeline. Since 2024, ten KCT students have participated in the Senior Design Program, applying classroom knowledge to solve real operational challenges alongside industry partners. These students came to Industrial and Systems Engineering department to do the Senior Design program. Notably, four of these students have subsequently progressed into NIU's Industrial and Systems Engineering master's programs, demonstrating how the experience not only strengthens technical and professional skills but also inspires continued academic advancement.



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Designed at Kumaraguru. Tested at Monaco.

How Team Sea Sakthi turned undergraduate engineering into internationally recognised innovation.

Engineering Beyond the Classroom

Representing India at the Monaco Energy Boat Challenge 2026 placed Team Sea Sakthi in an international arena where engineering ideas had to perform beyond simulations and laboratories. As the Electrical Subsystems Lead, I worked on one of the most critical aspects of the boat—building and integrating an electrical propulsion system capable of performing reliably under demanding competition conditions.

The experience required much more than technical knowledge. It demanded the ability to design, integrate, test, troubleshoot, and make decisions as a team when systems did not behave as expected.

My responsibilities covered the complete propulsion ecosystem—from high-voltage battery architecture and motor controller commissioning to liquid cooling, CAN communication, Battery Management Systems (BMS), and full propulsion-system integration.



From Components to a Complete System

A major capability developed through the project was understanding how individual engineering components must function as one interconnected system. I worked on the integration of a PMSM-based electric propulsion system using an EMRAX motor and EMDrive controller, including controller commissioning, encoder calibration, current and torque tuning, and CAN-based diagnostics.

The team also developed expertise in high-voltage battery architecture, modular battery packs, Master-Slave BMS configurations, marine electrical safety, telemetry concepts, and low-voltage systems.

Thermal management presented another significant engineering challenge. We designed and validated a liquid cooling system for the battery and motor, combining component benchmarking with thermal analysis and extensive testing. Every stage—from design choices to full-scale validation—required the team to move continuously between theory and real-world performance.



Learning Alongside the World's Best

One of the most valuable aspects of Monaco was discovering where Team Sea Sakthi stood in a global engineering environment. **Many participating teams included postgraduate researchers and experienced engineering students, while Team Sea Sakthi was among the few undergraduate-only teams.** Yet, several technical challenges we encountered were the same challenges being addressed by internationally established teams.

That realization was important: **engineering excellence is not about avoiding problems;** it is about developing the capability to understand, test, troubleshoot, and improve. Observing solutions developed by other teams also changed the way we approached engineering decisions. Some concepts we had previously set aside were being successfully implemented by high-performing international teams. It reinforced the importance of global benchmarking, questioning assumptions, and remaining open to revisiting earlier design choices.

Technical discussions with students, researchers, and industry experts further exposed us to advanced marine propeller optimization, international approaches to electric boat development, multidisciplinary teamwork, and different engineering cultures.



When Engineering Earns Recognition

The defining moment came when Team Sea Sakthi received the **Prince Albert II of Monaco Foundation Prize, along with a €25,000 Startup Grant**, for our innovative custom lithium-ion battery pack cooling system.

More Than a Competition

Monaco strengthened our technical capabilities, but its larger impact was on how we think as engineers.

We returned with a stronger appreciation for systems thinking, experimentation, global benchmarking, interdisciplinary collaboration, and engineering under real-world constraints. Most importantly, the experience showed us that an undergraduate student team can do more than participate on an international stage. With the right combination of technical depth, persistence, teamwork, and willingness to learn, it can contribute ideas that earn recognition alongside some of the world's emerging engineering talent.



For the team, the recognition represented more than an award. It validated our ability to take an engineering problem, develop our own solution, test it under demanding conditions, and demonstrate its relevance on an international platform.

Bavin V
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Engineering Beneath the Surface: Team InCraft at eISR 2026

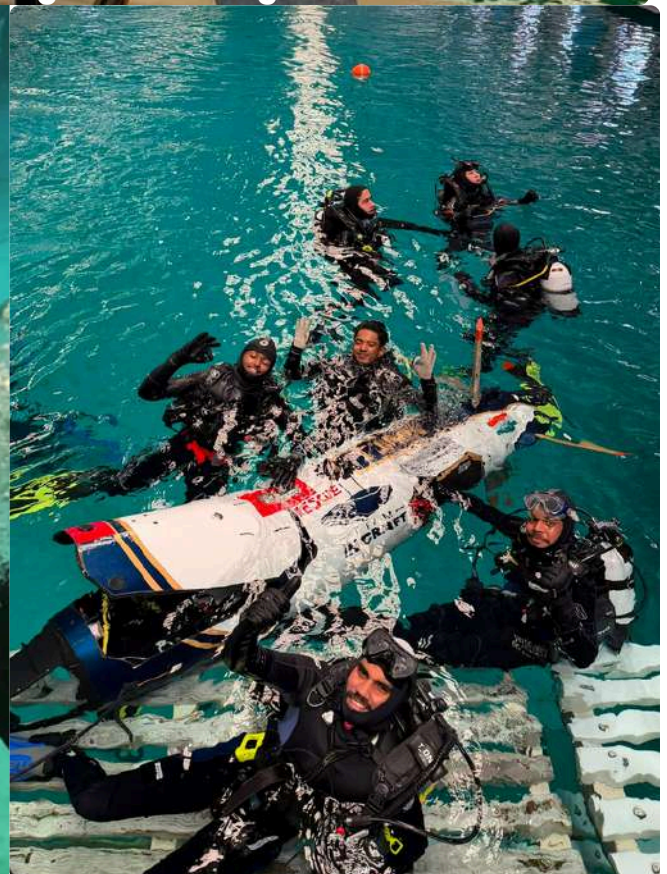
Into Uncharted Waters

Representing Team InCraft at the **European International Submarine Races (eISR) 2026** in the United Kingdom was much more than participating in a competition. It was a journey that challenged us technically, professionally, and personally.

As the **first Indian team** to participate in eISR and the first Indian team to bring home an award, we entered an environment that was completely new to us. Working in an unfamiliar country, away from our regular resources and support systems, meant that every technical issue had to be solved with the knowledge, tools, and creativity we had on hand.



"Engineering is not just about designing and building; it is about adapting, thinking critically, and finding solutions together."



When Competitors Become Collaborators

One of the most valuable aspects of eISR was interacting with teams from around the world. We exchanged ideas with experienced teams and learned from both their successes and failures. Being there also helped us understand the exceptionally high standards set by international teams.

What impressed us most was their willingness to collaborate. Despite being competitors, teams openly shared knowledge, offered suggestions, and helped others overcome challenges. It showed us what engineering communities can achieve when learning is valued over competition.

At eISR, we discovered that some of the best learning happens when competitors are willing to learn from one another.



A Recognition to Remember

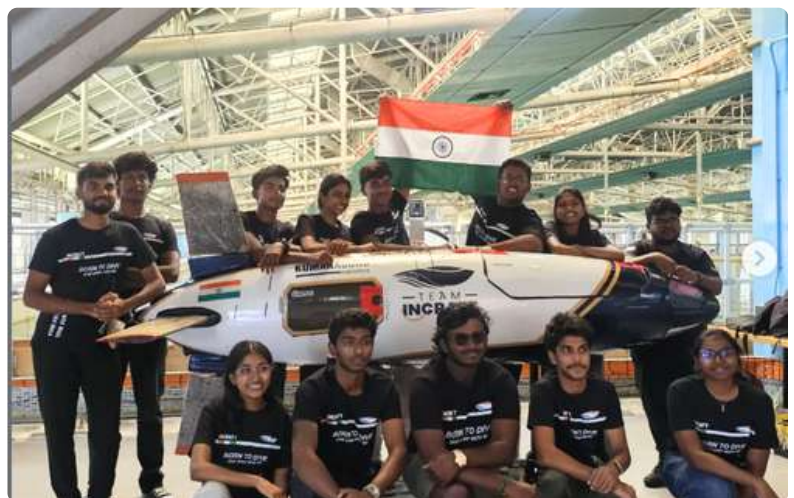
The highlight of our journey was receiving the IMarEST Sustainability Award. Being recognised on an international stage was a proud moment, not only for Team InCraft but also for Indian student engineering. The award validated the effort, dedication, and belief that took us from an idea in a workshop to a global competition arena.

Learning Beyond the Competition

Our time in the UK was equally memorable beyond the competition venue. Living abroad, meeting people from different cultures, and adapting to a new environment was refreshing and eye-opening. Staying in a caravan park alongside other participating teams created a vibrant and friendly atmosphere. Whether discussing submarine design, sharing stories, or simply spending time together after a long day, every interaction added something to the experience. The kindness and hospitality we encountered ensured that we never felt like strangers.

Young Engineers, Fresh Perspectives

Team InCraft itself is unique. A large portion of our members are first- and second-year students, whose curiosity, open-mindedness, and willingness to learn brought fresh perspectives to every challenge. This diversity of ideas helped us explore solutions that we might not otherwise have considered. The experience showed us that innovation is not limited by age or experience—it grows when people are curious, willing to contribute, and ready to learn from one another.



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Harnessing the Wind with Sustainable Innovation

From Plant Fibres to Custom Generators: How a Coimbatore Student Team is Reimagining Wind Turbines

A Small Team With a Big Idea

Somewhere between a college workshop in Coimbatore and a wind-testing facility in the Netherlands, a group of engineering students decided that a wind turbine could be more than a machine. It could be a statement about how India's next engineers choose to build things — lighter, cleaner, and smarter than what came before.

That team is Sulal, from Kumaraguru College of Technology. They design and build small wind turbines that turn even the gentlest breeze into usable electricity, and they do it while keeping sustainability at the centre of every decision. Their turbine recently travelled to the **International Small Wind Turbine Contest (ISWTC)**, held at TU Delft and Hanze University in the Netherlands, where Team Sulal represented India and returned home with a **second-place finish in the sustainability category** — a recognition that validated years of quiet, careful engineering.

What makes Team Sulal's story worth telling isn't just the result. It's the way they got there: by treating wind energy as a problem that mechanical, electrical, and materials engineering had to solve together.

One Team, Three Engineering Stories

Every small wind turbine has to answer three quiet questions before it ever spins a single blade: What shape will best catch the wind? How will that motion become electricity? And what will it all be made of, so the planet doesn't pay the price for clean energy? Team Sulal split itself along exactly these lines — aeronautical, electrical, and materials engineering — and let each domain push the design forward in its own way.



Harnessing the Wind with Sustainable Innovation

01 Aeronautical Engineering — Shaping the Wind

The aeronautical team focused on how the turbine interacts with moving air, designing blades that begin rotating efficiently even in light, unpredictable winds. Instead of waiting for strong gusts, the rotor is optimized for low wind speeds common in rooftops and open-field installations. An active pitch control system further improves performance: three compact motors inside the hub independently adjust each blade's angle in real time, allowing the turbine to continually adapt for maximum efficiency and safe operation.



02 Electrical Engineering — Turning Motion Into Power

The electrical team designed and built a custom generator tailored to the turbine's low-wind performance. Conventional generators require higher rotational speeds before producing electricity, but Team Sulal engineered the generator's magnetic layout to reduce internal resistance significantly. As a result, electricity generation begins almost as soon as the blades start turning, ensuring that the energy captured from light winds is converted into usable power efficiently.

03 Materials Engineering — Building Green From the Inside Out

The materials team reimagined the turbine blade using a three-layer bio-based structure. A carbon-fibre outer layer with sustainable resin provides strength and durability, while a kenaf fibre core reduces the embedded carbon footprint without compromising structural performance. Kapok fibre forms the lightweight inner core, maintaining stability while minimizing weight. Despite the manufacturing challenges of natural fibres, the team achieved blades that combine engineered performance with improved environmental sustainability.

What the Team Took Away

Beyond technical expertise, Team Sulal discovered that successful engineering depends on collaboration. Aerodynamics, electrical design, and materials engineering evolved together, with each discipline shaping the others. The turbine became not only a prototype but also a demonstration of interdisciplinary problem-solving.

Looking Ahead

By combining low-wind aerodynamics, a custom low-cut-in-speed generator, and bio-based composite blades, Team Sulal has demonstrated that performance and sustainability can advance together. More than a working turbine, the project represents what determined students can achieve when multiple engineering disciplines unite to solve a common challenge.



Navin TK
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From Curiosity to Research: A Journey Shaped at KCT

How practical learning, strong foundations and confidence guided my path from civil engineering to railway research

During my undergraduate years at Kumaraguru College of Technology, one of my professors asked me where I hoped to pursue my master's degree. I remember answering, almost instinctively, "Somewhere at a dream university like TUM." At the time, it was an aspiration rather than a carefully mapped plan. I did not know exactly how I would reach it, which specialisation I would eventually choose, or that my journey would lead me towards railway research.



Looking back now, after completing my master's degree and progressing into doctoral research, I realise that the foundation for that dream was already being built during my years at KCT. KCT was my preferred choice for undergraduate study because I had heard a great deal about the academic and personal development it offered its students. What attracted me most was its emphasis on applying classroom learning to practical situations. I had also observed the confidence with which KCT students and graduates carried themselves—whether in technical discussions, presentations or professional environments.

That combination of academic strength, practical exposure and personal development gave me the confidence to pursue Civil Engineering, a field I genuinely wanted to build my career in. When I first entered KCT, I was curious, but also slightly overwhelmed. The campus offered so many opportunities, activities and possible directions that it was initially difficult to decide where to focus. Over time, however, I learned to streamline my interests, recognise what genuinely motivated me and make better use of the opportunities available.

The student I was at KCT once dreamed of building a meaningful professional journey. What I did not realise then was that KCT was already laying the foundation for the person and professional I would become.

Finding My Direction Through Engineering

The flexibility offered through open electives allowed me to explore subjects beyond the immediate curriculum and gradually shape my academic interests. Compulsory presentations, communication activities and soft-skills training also proved invaluable. What once felt like academic requirements became skills that helped me confidently present ideas, explain technical concepts and engage with academics and industry professionals from different countries. KCT taught me not only how to solve engineering problems, but also how to communicate my reasoning clearly and continue learning independently.

One subject that particularly shaped my direction was Highway and Railway Engineering. It sparked my curiosity about transport planning and the relationship between infrastructure, mobility and cities. Over time, I became increasingly interested in railway systems—particularly the interaction between vehicles and infrastructure, maintenance challenges, and the need for safer, more reliable and sustainable public transport.

That growing interest ultimately led me to pursue a **master's degree in Rail, Transport and Logistics at TUM Asia in Singapore.**

From Strong Foundations to Independent Research

During my master's studies, I began to appreciate the strength of the foundation I had received at KCT. I needed less background preparation in several technical areas because the fundamentals had already been firmly established. More importantly, KCT had trained me to connect theoretical concepts with practical engineering situations. This helped me move beyond simply understanding a concept to questioning how it could be applied, adapted or improved to address real-world challenges. That ability became especially important as my academic journey progressed from coursework to independent research.



Researching the Future of Railway Maintenance A Journey Shaped Over Time

Today, as a doctoral researcher, I work on train-based monitoring of railway-track performance, using vibration and other measurements from operating trains to identify changes in track condition and support predictive maintenance. Research requires the confidence to begin with an unanswered question, learn from unsuccessful attempts and continually refine the work. KCT prepared me for this process through strong technical fundamentals, practical application and independent learning—skills that continue to support my PhD journey.

The student I was at KCT would probably be surprised—and very happy—to know that the dream university she once mentioned eventually became part of her journey. Yet reaching this stage was not the result of one dramatic decision. It was shaped gradually through subjects that sparked curiosity, opportunities that strengthened my abilities, professional experiences that clarified my interests and mentors who encouraged me to think beyond the path immediately in front of me.

My message to current KCT students is simple: make full use of every opportunity. An elective, presentation, project or industrial exposure may seem small at the time, but its value may become clear years later in higher studies, research or professional life. *For me, KCT provided the foundation to become an engineer and the confidence to remain curious, pursue new directions and build my own path.*

Sudeekshna Vijayaraghavan
Doctoral Researcher
TUM Asia, Singapore

Beyond the Classroom: Kumaraguru Students Experience Innovation Without Borders at AIT, Thailand

For eleven immersive days, 32 students from Kumaraguru Institutions stepped into a truly global classroom at the **Asian Institute of Technology (AIT), Thailand**, where learning extended far beyond lectures. What began with an orientation and campus tour soon evolved into an enriching journey that blended international exposure, interdisciplinary learning, cutting-edge technology, research, industry engagement, and cross-cultural collaboration.

The programme, "**Agrotechnology Innovations toward Sustainability in Agriculture and Food Systems in the Context of Climate Change**," challenged students to view agriculture not as an isolated discipline but as a convergence of engineering, biotechnology, business, policy, artificial intelligence, and sustainability.

Students explored how agricultural policies shape food security across ASEAN nations before discovering how biotechnology is transforming everyday life through robotics, AI, augmented reality, healthcare innovations, and translational research. The programme encouraged them to think beyond conventional academic boundaries and appreciate the interconnected nature of modern scientific challenges.



Sustainability emerged as a recurring theme throughout the programme. Sessions on climate-smart agriculture, sustainable business models, and organizational innovation demonstrated that future agricultural solutions demand equal attention to economic viability, environmental stewardship, and social responsibility. Students learned that innovation succeeds only when technology, policy, and people work together.

Learning became tangible through visits to some of Thailand's premier innovation centres. At Kubota Farm, students witnessed precision agriculture in action—from driverless tractors and satellite-guided machinery to smart greenhouses, agricultural drones, vertical farming, and intelligent crop management systems. These technologies illustrated how digital transformation is redefining farming across Asia.



A visit to Thailand's National Science and Technology Development Agency (NSTDA) exposed participants to high-throughput plant phenotyping, advanced imaging technologies, and hydroponic cultivation of medicinal plants. These experiences revealed how data analytics, automation, and controlled-environment agriculture are accelerating research and improving crop productivity.

Industry immersion added another dimension to the experience. At the CP-Meiji Dairy Processing Plant, students observed industrial-scale yogurt manufacturing, stringent quality assurance systems, automation, and food safety protocols, gaining valuable insights into how scientific principles are translated into efficient commercial production.

The academic sessions continued to broaden perspectives through hands-on exposure to applied data analytics using SPSS, plant biotechnology, genomics, hydroponics, vertical farming, and systematic research methodology. Visits to greenhouse research facilities enabled students to connect classroom concepts with ongoing scientific investigations, strengthening both analytical and research skills.



Equally inspiring was the interaction with Jerlin Raj, a Kumaraguru alumnus and Senior Vice President at Black & Veatch, whose career journey reinforced the importance of curiosity, lifelong learning, resilience, and embracing global opportunities.

By the end of the programme, students returned with much more than technical knowledge. They carried home a global outlook, deeper appreciation for interdisciplinary collaboration, confidence in research, exposure to world-class innovation ecosystems, and the conviction that the future belongs to professionals who can seamlessly integrate technology, sustainability, and creativity.

The AIT experience was not merely an international study programme—it was a transformative journey that prepared Kumaraguru students to become globally competent innovators ready to address the complex challenges of tomorrow.

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Capital Population Currency	Stockholm 10,710,242 (Estimated, 2026) Swedish Krona
Important Cities	Stockholm, Gothenburg, Malmö, Uppsala, Halmstad, Vasteras, Helsingborg, Lund, Jonkoping, Halmstad
Industry	Energy, Technology, Mining, Life Science, Agriculture and Food
Higher Education Institutions	Around 39 Public universities,
Academic cycles	Two primary intakes Autumn (Mid Aug-Sep) Spring (Mid January)
Popular Programs	Engineering and Technology, Business and Management, Environmental Sciences, Life sciences, Medicine
Visa policies	Apply for Resident Permit for Studies , which enables you to stay for more than 3 or 4 months. Before applying, have your admission letter, first semester fee payment done
Post-study options	Apply before the Student’s Resident Permit expires. The post-study visa is valid for 12 months for master’s and 18 months for PhD. Enables a student to find a job or start business. After the job transition to work permit visa.



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