
# SUPACAT PIONEERS AUTONOMOUS VEHICLE SYSTEMS WITH UNIVERSITY OF EXETER IN 'OUTSTANDING' KTP

**Supacat, the UK engineering company and world leading developer of high mobility defence vehicles, has collaborated with the University of Exeter to accelerate the application of autonomous vehicle systems for off highway transportation. Their Knowledge Transfer Partnership (KTP) pioneered the development of an optionally crewed version of the All-Terrain Mobility Platform (the ATMP), one of the world's most widely operated and versatile off-road military vehicles. The Project was Awarded A (Outstanding) grade.**

## The KTP Aims

Supacat Ltd (part of the Honiton, Devon headquartered SC Group) is an engineering company with world-leading expertise in the design, manufacture and support of high-mobility transport operating in harsh environments. After first collaborating with the University of Exeter on a KTP to hybridise the All-Terrain Mobility Platform (the eATMP), the company wanted to develop an optionally crewed /autonomous system for operating the vehicle. Such technology would allow the vehicle to operate itself in harsh, off-road terrain, removing the human from hazard and give Supacat sector-leading expertise and capacity in developing optionally crewed vehicles.

For the two-year Knowledge Transfer Partnership, Supacat worked with KTP associate Yashovardhan Katare and University of Exeter Professors Chris Smith and Prathyush Menon, Director and Deputy Director at the Centre for Future Clean Mobility, to develop a fully autonomous capability for the vehicle. This involved developing all aspects of the technology – from intelligent control systems to the integration of object detection and response algorithms for environment protection – to ensure the new, autonomous vehicle retained its signature performance in transporting heavy loads across harsh, unpredictable terrain.

## The Key Results

— The KTP succeeded in converting an all-terrain mobility platform (the ATMP) to an optionally crewed vehicle, with a high payload (best in class) capacity that can carry up to a 1.6 tonne load with or without a human on board using remote operation, including the creation of 'open architecture' interfaces to a range of OEM autonomy packages.

— The company developed the ability to incorporate intelligent control systems into its products on a scale from driver assistance to full autonomy, whilst being able to physically demonstrate this capability to customers.

— Key autonomous technologies were embedded within the company. These included:

o Simultaneous Localisation and Mapping (SLAM), the computer-led process of mapping an unknown environment using the vision-based sensor information, while keeping track of a vehicle's location within the environment

o Developing algorithms that enable the vehicle to detect and respond in real-time to objects in its surrounding environment,

o Integrating the new technology with the vehicle's architecture to monitor and control its operation from a remote ground station or mothership.

o Commencing integration of the new technology with a third-party planning system to facilitate end-to-end, unmanned logistics supply.

o Providing the core technology base for the vehicle to take part in future teaming applications

— The company generated £400,000 increased sales revenue during the KTP and expects to achieve increased revenue of £8,600,000 over the next three years, due to capability developed through the two KTPs.

— The company has already undertaken full software system engineering in house for two major prestige projects for other Original Equipment Manufacturers (OEMs).

— In addition to this, the company has formed a joint autonomous 'ecosystem' with several OEMs to partner on future opportunities.

## Benefits for the company

*"The 3-way partnership has been extremely effective, with the University of Exeter providing deep subject matter expertise applied in an industry-sensitive way and the associate proving to be an outstanding candidate.*

*The company has moved from a position of 'not knowing what it didn't know' about autonomy to confidently understanding the subject and what is involved to incorporate intelligent control systems into its products on a scale from driver assistance to full autonomy, whilst being able to physically demonstrate this capability to customers on the optionally crewed-ATMP.*

*These factors will ensure the company accelerates the profitable application of the capabilities acquired through the KTP through optionally crewed vehicles and intelligent control systems across a number of industry sectors. This outcome was uncertain when the KTP commenced and for this reason, it has exceeded our expectations.*

*The 3-way partnership has been extremely effective, with the University of Exeter providing deep subject matter expertise applied in an industry-sensitive way and the associate proving to be an outstanding candidate. Yash has world class technical skills and a veracious appetite for working and learning, combined with the softer skills normally only acquired through a longer period in the workplace (e.g. commercial acumen, communication, presentation, stakeholder management and time management skills).*

*The open-architecture approach that Yash has taken is very transferable to other vehicles and sectors. This we were very keen to take advantage of with the KTP, so the next project for us internally is to take that project to the HMT vehicle.*

*We absolutely foresee that there will be other KTPs that we run with the university, while our current focus – having recently completed two on hybridisation and autonomy – is on fully embedding that knowledge within the company.*

*From an industrial perspective, having a continual relationship with the University is essential. Not only does this link ensure that the fundamental research continues to drive cutting-edge technology forward, but applying this research to a customer base (such as the Ministry of Defence and the RNLI) often throws up questions that need a specific answer. When these problems arise, the relationship with academia is key and enables us to solve them."*

Steve Austen (Engineering Director) &
Mark Field (Principal Engineer), Supacat Ltd


## Benefits for the associate

*When working entirely in research and development (R&D), most of the time is spent developing technology to the absolute best it can be. However, while this process is crucial in driving forward developments, it doesn't always account for the different costs and business needs which are needed to successfully deliver this technology to industry. Coming from an R&D background, I was aware of the need to gain experience here and understand these different costs, processes and challenges.*

*The KTP's combination of industry placement and academic supervision was the perfect way for me to understand how to match up the latest R&D with the company's ambitions. Working at Supacat, I was able to appreciate how costs and efficiency inform projects from start to finish, and better understand the different moving parts and organisational practices which make those projects possible.*

*The KTP provided me with that perfect spot between research knowledge and business context.*

*This has hugely benefited my own working process, making me increasingly efficient and able to apply the most relevant R&D applications when developing products for the company. The KTP experience has been incredibly valuable not only for my work at Supacat, but my future ambition to become an entrepreneur, innovating and developing the technologies that introduce AI to platforms operating in multiple domains supported by formal education in business administration.*

Yashovardhan Katare, KTP Associate and
Autonomous Systems Engineer, Supacat Ltd

Yash is now employed at Supacat Ltd as an Autonomous Systems Engineer, where he works to develop end-to-end software control systems for the company and their clients.

In addition, the KTP has delivered many other benefits for Supacat Ltd, including:

- Transferred knowledge from the KTP to the development of a hybrid electric variant of Supacat's HMT vehicle as part of the UK MoD's Technology Demonstrator Programme 6 (TD6).

- RNLI proof of concept demonstration of the e-ATMP as a lifeboat launch vehicle in crewed and autonomous modes, providing the RNLI with insight into the feasibility and technology readiness level of e-vehicles in this environment.

- Applied learning from the project to the design of a new powered wheelchair `Victor` for Conquering Horizons.

- Employed two Full-Time Engineers from the KTP:
Yashovardhan Katare | Autonomous Systems Engineer
Matthew Harvey | Design Engineer


## Benefits for the academic team

*The Cooperative Robotics and Autonomous Networks (CRANE) Lab at the Centre for Future Clean Mobility specialises in developing and implementing autonomous behaviours in vehicles operating in land, air and sea. The KTP project offered a unique opportunity to involve in industrial research at a high TRL level. With this optionally manned/autonomous system, our focus now is on the operation in specific contexts, such as defence, logistics and emergency response sectors, especially fine tuning and incorporating the disparate mission requirements. Mission planning and developing teaming capabilities are our present interests.*

*The KTP with Supacat has fed back many key details and context-specific challenges in the guidance, navigation and control of ground vehicles in off-road as well as extreme environments. Compared with individually operated vehicles, for example, there's a greater challenge when operating these vehicles in extreme conditions and in team settings, where there are multiple agents and additional factors for the technology to account for.*

*The product, the two KTPs with Supacat have developed, is crucial for understanding the application of this technology, not only for the defence sector, but in other sectors such as logistics and emergency response. Being able to understand the drive behaviour of the system at Supacat in different modes, such as UGV and optionally manned deployment, in the defence sector also demonstrates its potential application to clients in other sectors, and similar concept to air and marine environment.*

*Another advantage is that we have been able to develop identical software interfaces at Supacat and the Lab. Going forward, this makes it much easier to transfer technology developments between platforms and will help to scale up such developments in future.*

Professor Prathyush Menon (Professor of Autonomy and Deputy Directorat the Centre of Future Clean Mobility), University of Exeter)

In addition, the KTP has delivered many other benefits for the University, including:

— The creation of an autonomous systems ecosystem with several companies, including Supacat, to form joint bids for relevant work. Cooperative Robotics and Autonomous Networks (CRANE) lab at Centre for Future Clean Mobility is actively collaborating with several industrial partners, including several SMEs in South West.

— Applying the learning from this project to develop new projects relating to other sectors such as agriculture, emergency response, and environmental monitoring.

— An academic publication for the Journal of Field Robotics is being prepared to share some of the project's advances with the international academic community.

— The academic team expects the KTP to make a strong impact case study at the next Research Excellence Framework assessment.

— The KTP project has provided practical examples for teaching modules in control engineering and nonlinear systems and control, allowing the University's engineering education to reflect advances in current technology and its fast-changing application.