SWAT

The challenging journey to self-driving

In Swat CEO Jarrold Ong's vision of the future of transport, autonomous vehicles play a big role. His company is one of two involved in the first phase of the Land Transport Authority's trial of on-demand public bus services that are routed in real-time.

TRANSPORT software startup Swat's chief executive officer Jarrold Ong is used to being on the move. Since his days as an intern in Silicon Valley in the National University of Singapore's Overseas Colleges programme, he has gone from one startup to another.

"I like building teams, I like building startups," says Mr Ong.

His current journey with Swat, however, has lasted quite a while. It began in late 2015 when he got to know Swat co-founder Arthur Chua, who was starting to look into the urban mobility space.

The two met, discussed a few ideas, and decided to work together on "a more demand-responsive ride-sharing solution".

Both men shared a vision of the future of transport: one in which autonomous vehicles play a big role.

"It was very clear to us that there was going to have to be some central command system for autonomous vehicles," says Mr Ong.

Teaching vehicles how to drive themselves is one thing; figuring out where vehicles should go is another. The latter area was where Swat saw an opportunity.

Furthermore, this route-planning capability would be useful not just in the autonomous-vehicle-reliant future, but in today's transport systems with conventional vehicles.

Over six months, the team worked on the first version of an algorithm that could generate ride-sharing routes depending on rider demand, running simulations to test it.

In the next three months, they moved to a "real production system", having created apps for use on both the operations side, and by users.

In August 2016, Swat's ride-sharing service was launched, serving Singapore from Ang Mo Kio down to the central business district, during the morning peak of 7am to 10am.

Their proposition: taxi-like services at bus-like prices, with on-demand rides for a flat fee of S$5.

SELLING SOFTWARE

Swat started with a fleet of five buses, and now has 25. They also offer pre-bookings and fixed routes, and have recently started offering a limited evening service.

Yet these business-to-consumer operations are ultimately meant as a pilot and testing ground for Swat's real business: its software.

The next stage for the company is to sell its software to businesses and governments, says Mr Ong.

In Singapore, Swat has already begun to make inroads. It is one of two companies involved in the first phase of the Land Transport Authority's (LTA) trial of on-demand public bus services that are routed in real-time. Called in August 2017 and awarded in February 2018, the tender received 10 proposals from both local and overseas hopefuls.

In the first phase, Swat – the other company is Via – is developing a matching and routing algorithm for deploying buses to match real-time commuter demand, and conducting simulations.

In the next phase, to be awarded during the third quarter of 2018, the successful tenderer or tenderers will work with the LTA and public bus operators to test and calibrate the solutions.

Then in the fourth quarter, the operational trial will begin, with real trial services for commuters.

Aside from that trial, Swat is making preparations for an even more distant future. Currently, its algorithm plans routes for a four-hour shift "because that's the maximum for human drivers", says Mr Ong.

Yet the system has the ability to plan routes for much longer spans of time, such as an entire day or even a week, if and when human limitations are no longer a concern.

Granted, Mr Ong expects the rise of autonomous vehicles to be gradual. Such vehicles will likely be used in limited scenarios at first, such as fixed routes, he says.

But that is no reason to hold back on research and development, he adds: "We didn't want to wait for autonomous vehicles to come (before developing the system). So when the opportunity finally comes, we'll be ready."

That is not the only aspect where Swat's computational capabilities outstrip current applications.

Swat's ride-sharing service now pools seven to 10 trips a time. The algorithm is actually capable of pooling more than that – but that would involve re-

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ducing the quality of service.

Technological limitations are not the only ones, Mr Ong notes: "The problem is not just about the computer science."

Consumer preferences must be considered too: "How do you get people to share vehicles and be on time for their pick-up?"

For a startup like Swat, which focuses more on developing software than being a transport service provider, there is another set of stakeholders whose preferences must also be addressed: the service providers themselves.

Transforming the transport landscape is not just about providing a clever solution, but giving industry players a reason to adopt it.

EARLY LESSON

Swat had to learn this early in its journey. Reveals Mr Ong: "When we started our company, we didn't want to actually operate a fleet."

In speaking to fleet owners and operators, however, the Swat team learned that current industry norms did not create an incentive to adopt its software.

Instead, it was quite the opposite. When fleet owners told Swat "Your system will reduce the number of buses I need", they were not welcoming the possibility of greater efficiency, but pointing out a flaw.

This was because fleet owners typically charge their clients based on the number of buses provided.

Without an industry partner, Swat thus had to run its own fleet in order to pilot its application.

The firm also had to reconsider its software's selling points. The new approach is to highlight how it can improve service quality.

For instance, corporate transfer services today tend to ply fixed routes, notes Mr Ong. "We're trying to sell a more customised door-to-door service."

Furthermore, Swat's software will be able to track how long each commuter spends on the bus, and ensure that this does not exceed a certain threshold – a boon to anyone who understands the pain of being the first to be picked up or the last to be dropped off on company transport.

Besides improving the commuter experience, this user-sensitive approach could require more buses, allowing fleet owners to command higher rates, adds Mr Ong.

The challenge, of course, is that "at the end of the day, corporates don't want to pay more". Swat's ongoing task is to find a solution in which everyone gains: the corporate client buying transport services, the fleet operator supplying them, the employees using them, and Swat itself.

One reason for optimism is that the LTA tender has generated interest in Swat's work.

"Even the fleet owners want to try it now," says Mr Ong. In 2016, fleet owners were less keen on the idea, and would simply ask Swat what could be expected in terms of revenue and number of rides provided.

After the award of the tender was announced, however, Swat saw a change in attitudes: "They are more keen to start a pilot today."

Today, a fleet operator's competence is built in large part around their team of drivers, says Mr Ong. With the rise of autonomous vehicles, that competence will be eroded.

More industry players might be waking up to that potential future, he adds: "Maybe they realise this is a direction they should be going in."

Since the LTA tender award, Swat has also received more interest from both government and corporate bodies about going overseas.

Swat is currently working with one public transport operator to explore on-demand bus services in Australia and the United Kingdom.

Enterprise Singapore is also partnering the firm to look at internationalisation opportunities in places such as China and Vietnam.

"We hope that maybe next year (2019) we'll start actually doing some work overseas," says Mr Ong. "Cities in general, they want to try this out."

In other countries, some transport startups "have left a bad taste in governments' mouths", he notes tactfully. Swat has no intention of winging it: "We prefer to actually work with the authorities to come up with solutions."

GROWING THE TEAM

Future areas of exploration for the firm include commutes from rural areas to cities, and airport transfers.

To support the LTA tender as well as its growth plans, Swat's focus in 2018 has been on growing its team. In February, when the tender was awarded, Swat had just 12 people. Today, the team has grown to 28.

This expansion has taken some effort, notes Mr Ong: "One of the challenges has been getting people with a good data science background ... Local talent is very hard to find."

To that end, Swat is working with the National University of Singapore on internships, and also reaching out to the Singapore University of Technology and Design. In this, the startup's philosophy remains clear: make sure you have enough capacity for when the big change comes.

One thing that attracted head of data Evgeni Makarov to Swat was the originality of the company's core idea. Unlike some startups, Swat was not getting on a bandwagon. "It's not a startup that's a kind of copycat," he says.

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Different routes to the same startup

SWAT's data team includes engineers from research backgrounds and from big software companies; PhDs, working alongside an intern from the National University of Singapore; and citizens of Singapore, Malaysia, China, Vietnam, and Russia.

Not bad for a team that counts just six members, including head of data Evgeni Makarov.

This diversity is unsurprising in the context of Swat's overall culture, which Mr Makarov describes as being "very open to different views".

Originally from Russia, he had previously worked in various software companies and startups both here and abroad, in areas such as fintech.

But data analytics has increasingly become a skill that is desired in sectors outside tech – including more "traditional" areas such as land transport.

After several years in Singapore, Mr Makarov joined Swat in 2017.

He knew the founders from before Swat was formed, having worked with them on a commercial software development project in logistics.

One thing that attracted him to Swat was the originality of its core idea, he says. Unlike some startups, Swat was not getting on a bandwagon: "It's not a startup that's a kind of copycat."

At the time, the idea of ride-sharing for buses was new – and required much more complicated calculations than ride-sharing for cars or taxis.

In Swat, he and his team draw on Geographic Information System (GIS) or mapping data, as well as data on public commuter rides and traffic.

The firm also has a system for tracking its own vehicles, which analyses costs such as Electronic Road Pricing. All this goes towards Swat's software for optimising the performance of bus fleets.

One aspect of this is minimising parameters such as the total distance covered, to achieve greater efficiency.

But finding a mathematically efficient solution is not enough. "You need to consider that passengers have other (transport) options," says Mr Makarov. A good solution must also suit passengers' preferences. The second aspect of optimisation is therefore maintaining the quality of service, measured via variables such as waiting time.

Just as Swat has proven the place to be for engineers of various backgrounds, it hopes to provide solutions for a range of users too.