Inside Hong Kong technology

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We go incognito to look at what's happening under the surface in our city's tech industry

Although it may appear that Hong Kong is behind the market and the juggernaut evolution of our tech counterparts in Silicon Valley and Shenzhen, there's actually a movement gathering incredible force – an almost invisible network of development, technology and data research happening behind closed doors. We peel back the hardware and software to get under the skin of five areas changing and enabling the way we live, thrive and connect in the city

MTR's Artificial

The digital boss that oversees Hong Kong's railway system is meticulously efficient behind the scenes

The MTR is one of the busiest train networks in the world. It carries 5.2 million passengers every single weekday on its 10 heavy and 12 light rail lines, which operate over 218.2km of track and stops at 152 stations. With an incredible 99.9 percent on-time rate, the MTR really does keep our city moving.

But how is all this co-ordinated with such efficiency? The MTR network has a maintenance team comprising over 10,000 people who perform around 2,600 engineering works each week. But there's only a four-hour window each night when the trains aren't running in which to do the work. The answer might be surprising – the MTR uses AI, artificial intelligence, to keep itself running smoothly. This is the Integrated System for Engineering Works Management.

While the MTR's AI system is not quite the self-

conscious machine that's popularly portrayed in science fiction, it's still a very effective overseer that can sort out the weekly scheduling of maintenance works, decide what needs to be done, allocate the appropriate resources and choose the days in which the works are to be carried out – all without human intervention. Such autonomous decision making is a very complex process, but this means that the AI can perform tasks that normally require a highly experienced human to do. "The MTR in Hong Kong is the first and only rail operator in the world to use AI for engineering works optimisation," says Dr Andy Chun, chief information officer at City University and the designer of the AI programme. "Currently over 3,000 people, both within and outside MTR, use the system to provide details on engineering works that need to be performed."

The AI system took over two-and-a-half years to code and design, and it reaps huge benefits for both MTR and its passengers alike. Firstly, engineering works are performed on time and safely. Secondly, there are productivity gains and cost savings due to a more focused use of resources. The upshot is that our trains arrive on time, pretty much all the time.

So the next time you get on the MTR, stop for a moment to not only appreciate the humans who maintain the train tracks, but also the digital boss who is keeping an eye on things too. *Oswald Tsang*

Octopus

The colourful exterior of the city's most recognisable payment system conceals some smart equipment

An incredible 99 percent of 16 to 65-year-olds in our city own an Octopus card. In fact, 26 million of the small cards are currently in circulation, and are used to make a staggering 13 million transactions per day – in MTR stations, on buses, in convenience stores, at parking meters and in 14,000 retail outlets. The Octopus can also be used at access control points and can be integrated into your mobile phone, watch or even turned into a natty keychain. Making rapid, contactless payments by the iconic Octopus card is the epitome of the efficiency that Hong Kong prides itself on. Indeed, one transaction takes a whiplash-inducing 300 milliseconds to be processed. Daily transactions of the seemingly humble card total $150 million.

The outer covering of the card is made from tough PET plastic – its smooth surface is easy to customise and can be recycled. Within the plastic lies a thin motherboard, an internal antennae as well as the high tech Sony 'FeliCa' (Felicity Card) Radio Frequency Identification Chip (RFIC), which is the size of a grain of rice. The chip has its own Central Processing Unit and can both encrypt and receive signals. If an unknown reader attempts to communicate with the chip, all its data becomes encrypted as a '0' – protecting your money.

Hong Kong was the first city in the world to use the FeliCa chip, which can process transactions at a distance of 30 to 100mm from the card reader thanks to wireless radio signals that are picked up by the antenna. The card can also record the transaction history of the user – it has an internal memory up to 6.4kb. The card doesn't have an internal energy source, so energy is generated by a magnetic field produced by the Octopus card reader. Whenever the card is used, a small electronic current is produced by the antenna coil, giving the card enough energy to last until the next transaction. *Anna Cummins*

1. An antenna runs around the outside of the card and is only a couple of millimetres thick. It picks up wireless radio signals on an AM/FM frequency from the Octopus card reader and sends information to the FeliCa chip

2. There are no moving parts inside an Octopus card. This helps the card to be very stable and reliable during operation

3. Transactions between a card and a reader are processed at a speed of around 300 milliseconds

4. This is where the Sony FeliCa chip sits. It is smaller than a grain of rice. The chip has around 6.4kb of memory and can store users' transaction histories. The chip is able to process contactless payments 30 to 100mm away from a reader

5. There is no internal energy source inside the card.

Instead, an electric current is generated by a magnetic field given off by the card reader during each transaction.

Bitcoin

A gold rush for bitcoin mining is fuelled by an innovative cooling system

What you see here are rows and rows of servers at work analysing algorithms, nestled in an undisclosed industrial building in Hong Kong. This image is just one representation of the masses of 'mining' servers in the city but 'bitcoin mining' in particular is quickly becoming one of the more lucrative industries.

Although the concept of 'mining' isn't new – we've been manually analysing data for decades – the technology is. 'Mining centres' around the world are now growing in tandem with companies and industries that focus on consumerism, such as huge retailers, software developers, the NSA and bitcoin technology. Mining bitcoin works like this – the server completes an algorithm or transaction correctly, and the result is more bitcoin. "Transactions are verified – it's a peer to peer network of miners and other nodes," explains Jehan Chu, bitcoin investor evangelist and founder of Ethereum HK Meetup Group. "There are all these miners around the world, thousands and thousands of them, that make up a network larger than all the super-computers of the world combined. There's no central point of failure." Because mining bitcoin is so ungoverned and vast, companies are seeking leverage by developing faster, more cost-effective ways to mine bitcoin (currently, it is very costly). One company in Hong Kong, Allied Control Limited, is changing the game by developing a revolutionary new cooling immersion system.

Utilising bubbling water tanks to monitor and cool servers – they're 'immersed' in water – Allied has provided its unique technology to its clients' data mining centres as well as setting up their own bitcoin 'mining centre', one of the largest in Hong Kong.

The open bath immersion system saves energy and space costs by cooling down the servers, ensuring they work faster and longer mining bitcoin

Other companies in Hong Kong are also now turning to developing immersion cooling systems. "You're effectively turning electricity into money – so the cheaper you're able to do that, the more profitable the mining becomes," says vice-president of operations, Kar-wing Lau. "We save 99 percent of cooling electricity, essentially cutting the average data centre electricity consumption in half, and, due to much higher density as well, we're saving 87 percent of space. As a nice side-effect we hope to contribute to cleaner air if more data centres use our technology." The company has won several awards for its system, which is being picked up in Silicon Valley as well as by the local government. The only other location in the world where this kind of cost-effective technique is being prominently developed is Iceland, where sub-zero temperatures naturally cool the servers. The clue to what happens next in the bitcoin gold rush lies within the bubbling chambers. *Ysabelle Cheung*

Tech Students

A small army of forward-thinking students drive the city's technology development

Why haven't we reached the status of Silicon Valley yet? It might seem like an absurd question to ask, but at the Hong Kong branch of General Assembly (GA), a technology school originally founded in New York, the question is not 'why' but 'how'. How can we transform thinkers into creators?

“GA started with one class. At that point, two years ago, we were educating people on a very basic level: ‘what is web development? What is digital strategy? Why should you care?’” explains Kalina King, regional director of General Assembly Asia. “In the past year and a half our audience has grown 900 percent. We’ve grown past the stage of ‘what is this?’ to ‘I want this, I want what’s next, I want to learn more and do more’.”

GA opened up its first school in New York back in 2011, but it quickly spread across the country, to the UK, Australia and to Hong Kong, the only one so far in Asia. GA Hong Kong offers full-time immersive courses as well as part-time courses, from web development to digital marketing (one of its most popular) to data science. You might recognise some of the tutors in there, too. Some of them are from Google, Tumblr, Reddit, experts in their field drawn to GA’s unique, pragmatic focus on technology. The school is the first of its kind in a teaching environment in Hong Kong – while there are venues to study technology, it’s usually in a more academic and abstract setting. Apprenticeships are even scarcer.

King mentions that there are three types of students that walk through GA’s doors: those firmly established in their careers hoping to upscale their skills, those hoping to make a career change and young entrepreneurs seeking the tools to kickstart their own businesses or startups. Those who fall under the first umbrella include huge corporate clients such as Swire and Bloomberg. “Hong Kong people definitely have the acumen and often have the engineering of a business mindset to do well in courses like web development,” says King.

One former alumni, Cindy Yen, took the front-end development course last year while juggling a full-time job in finance. “I remember staying up until 4am to finish assignments!” she says with a laugh. But it was worth it. After the course finished, Yen quit her job in finance, secured a new job as a strategist – “You don’t see many strategists with web development skills,” she says – and is due to launch her own startup app, Glance, early next year. “It’s always been my dream to work with 3D tools, but I didn’t realise what I could do with my choices. I had no idea where to start. GA has a very clear set of goals. I couldn’t have done this without them.”

Yen’s is not the only success story – there have been hundreds of alumni slowly filtering into Hong Kong’s technology industry. The people at GA are likely to be the ones behind accelerators, venture capital companies and shared workspaces such as Cyberport’s sprawling, 40,000sq ft Smart Space. But the skills developed and being taught at GA could just as easily apply to sectors desperately needing a tech boost.

“Hong Kong is a globally competitive industry in finance, real estate, manufacturing, shipping, and there are experts in those fields. There’s a lot of money even if it’s not used to invest into tech, yet,” says King. “Hong Kong has all the components for a tech boom or entrepreneurial boom to come.” YC

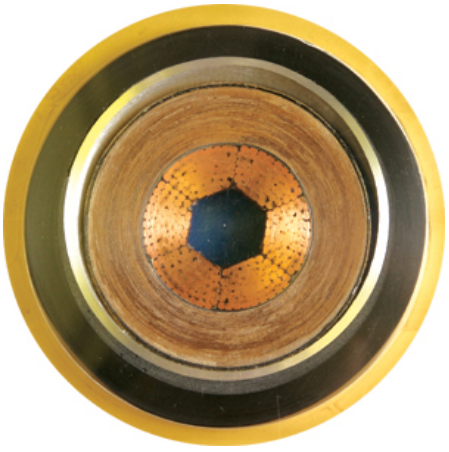
For more info on General Assembly, check generalassemb.ly/hong-kong.

Electric Cable

The electricity that courses into homes on the Island has

to first traverse huge underground tunnels

Ever wondered why you don't see power lines on Hong Kong Island? If you happen to live there, next time you plug your phone in for a charge, spare a thought to the electricity that powers your social media addiction – it flowed through a vast network of tunnels under the city just to get there. In the past, electricity was transmitted from Lamma Power Station to Hong Kong Island by underwater cables and then sent over the mountains to its destination by overhead lines. But as demand for power increased, the large cables became excessive and unsightly. Digging down was considered the only option, and so the Island's network of high voltage electric cables were almost completely buried in a series of expansive tunnels – carrying the added advantage of protecting the supply from typhoons.



A cross section of a 275kV fluid-filled PPLP insulated cable, which runs through the tunnel

The first tunnel, Wah Fu to Bowen Cable Tunnel, was built in 1988 and runs under the middle of Hong Kong Island for 3.1km, from Wah Fu to Wan Chai. The second to be built was the Nam Fung to Parker Cable Tunnel, which runs from the southeast of the island to the northeast of the island. At 5.7km, it remains one of the longest cable tunnels in the world. There are now a total of six of these tunnels; four on Hong Kong Island and two on Lamma Island.

Tunnel locations

The electricity supply is provided by HK Electric, which powers Lamma, Ap Lei Chau and Hong Kong Island. Last year, HK Electric sold 10.8billion kWh of electricity to 0.57million households and businesses. The flow of all this power is monitored at the System Control Centre in Ap Lei Chau. The centre co-ordinates the generation, transmission and distribution of electricity, as well as handling system outages and emergencies. It is open 24 hours a day every day of the year. Huge wall displays update the engineers at the centre with real time information about the grid. *Anna Cummins*

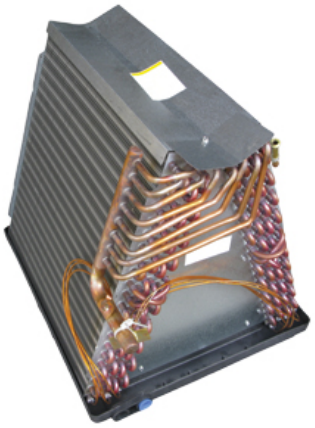
Air Conditioners

They sit in every corner of every building, fanning us with Freon breezes. But how exactly do they work – and could we improve them?

It's fair to say there's barely a building in the city that doesn't possess a small white box, cooling our tropical climes. Central air conditioning relies on a system of ducts to carry air from an outdoor handling unit into the interior of the building. Copper tubing runs through the evaporator, which is the part you see inside the room, and a refrigerant (usually Freon) circulates through these tubes, absorbing heat from the passing air and cooling it down.

Air conditioning accounts for 30 percent of the city's total

energy consumption – 60 percent in the summer. Six kilos of CO2 are emitted by one air con unit in one night. It's something that Jacky Lai, an engineering student at City University, is trying to solve. He has designed a prototype 'Humanised Variable Air Volume Air Conditioning System', which can be installed on existing central air conditioning units. Lai estimates his design could reduce their energy consumption by 10 percent and the idea won him first place in the Samsung Solve for Tomorrow competition back in May.



Jacky Lai's prototype

"Sensors in the grilles can detect temperature, CO2 levels and human motion. It then controls the air supply accordingly," explains Lai of his invention. "It knows if people are in the room and can also tell if there's not enough oxygen, thereby improving air quality. The various units can communicate to each other, so they don't overcool. Most importantly, you don't need to redesign anything, you just replace the grille [with the new one]. The payback period is only one year, thanks to the energy savings."

Lai has a vision. "The topic of energy is so important, it's the main issue to solve in our world," he says. "Smart buildings are the future." *AC*

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