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LOW MARGINS MEANS EFFICIENCY FOR BIKE FIRMS IS VITAL

Using Big Data to make bike sharing more efficient

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Bike-sharing systems have been widely adopted in many major cities worldwide. There are currently 1,139 active systems across the globe, and with very good reason.

First, bicycles do not add to the carbon footprint or traffic congestion. Second, they are ideal for last-mile travel (from bus stops/train stations to home) in cities like Singapore.

Finally, compared with other modes of travel, biking is healthier.

After waiting many years on the sidelines, Singapore has taken the plunge into bike sharing. Unlike in

Singapore's private bike-sharing companies, such as Ofo, OBike and Mobike (above), allow bikes to be dropped off or picked up anywhere using GPS tracking. TODAY FILE PHOTO

other cities where bike sharing systems are government owned, we in Singapore have private bike-sharing companies: Ofo, OBike, and Mobike.

In traditional bike-sharing systems deployed across Europe and the United States, fixed docking stations for bikes are situated at various locations in the city. Each of these stations has a fixed capacity (typically around 20 bikes). Customers swipe a card at the docking station to get access to the bike, and they drop it off at another station near their destination.

These systems typically face two major concerns. The first is the fixed capacity of docking stations. When the station customers want to use is full, they are forced to drop off bikes at stations not near to their destinations.

The second is related to inefficiency in operations. Due to the individual movements of customers, there are many cases in which the bike supply far exceeds or falls short of demand.

The critical issue, then, is how to make bikes available to customers at the "right" locations, and at the "right" times. All the three bike-sharing companies in Singapore do not use docking stations, and allow for bikes to be dropped off or picked up anywhere using GPS tracking. This addresses the fixed-capacity issue that traditional bike-sharing systems may encounter.

Unfortunately, it introduces a more complex issue — of bikes being left at locations at which they may pose a hazard or impede pedestrian traffic. Moreover, there is no guarantee that the location is easily accessible.

Through government regulations, it is possible to force people to leave bikes only at designated bike-parking areas. However, this makes the efficiency issue far worse than the one faced by traditional bike-sharing systems, as many bikes will typically be placed at locations at which customers do not need them.

Given the low profit margins, tackling efficiency is key to the sustainability of privately owned bike-sharing systems.

Let us consider the analogy of shopping carts at supermarkets.

Before the introduction of trolley

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stations, customers would use the carts and leave them at random locations, making it hard for other customers to find a cart when they need one. Such imbalance or efficiency issues will arise — and on a much larger scale — for the bike-sharing systems in Singapore, as there is a higher chance of bikes getting dropped off at odd locations.

In fact, traditional bike-sharing companies, such as Capital Bikeshare in Washington DC, have shared their data sets and pointed to such efficiency and imbalance issues. At Capital Bikeshare, which has about 6,000 bikes, each day on average sees 500 instances of locations becoming empty, and 250 instances of locations becoming full.

There are two ways to address such inefficiencies.

The first is to employ trucks that take the bikes to places where customers need them the most, at different times of the day. Going back to the supermarket analogy, this is equivalent to hiring a person to constantly collect the shopping carts and bring them back to a location at the entry points.

The key difference in the case of bike sharing is that the radius of location is likely to be far wider (typically an entire city) than that of a supermarket. How can a repositioning system using trucks to relocate bikes be more efficient?

Our research on traditional bike-sharing systems offers some clues.

All the bike-sharing systems typically store data of bike usage by customers, and we have developed algorithms that analyse the data to identify customer bike-usage patterns. An example: Location A does not have any bikes available at 8am every day, while location B has many more bikes than needed at 7.30am.

Given these usage patterns, we identify paths for the trucks to pick up bikes from locations that have more bikes than required, and drop them off at locations where bikes are required.

In order to scale to thousands of locations across the island, we group together multiple nearby locations with a similar demand for bikes into regions, and perform repositioning of bikes at the level of regions.

Based on Capital Bikeshare dataset, our algorithms show a more than 40 per cent increase in customers being served due to improved efficiency over an entire year.

But this first method of using trucks, although useful in repositioning bikes, increases the carbon footprint, potentially offsetting the environmental gains of bike-sharing systems.

Therefore, we propose a second way, in which we place the onus on users, instead of intermediaries, to position bikes in the right locations. An incentive-based system, in which customers are offered a reward to leave the bikes at the desired locations — meaning locations where there is likely to be greater demand for bikes — could work.

Going back to the supermarket analogy, this system would correspond to the current mechanism of requiring a coin deposit to use the cart, with the deposit refunded when the cart is returned to the trolley station.

The key challenge in providing monetary incentives is balancing the trade-off between being attractive to customers (so they leave the bike at a location desired by the bike-sharing company) and being feasible (without making a loss) for the bike-sharing company. We have developed computational techniques that balance this trade-off by utilising bike-usage patterns observed from the data.

In other words, a budget can be set aside each day by a company for monetary incentives based on a certain projected revenue.

In terms of improved efficiency, this second method performs on a par or better than the first method of using trucks to collect bikes.

There are plenty of reasons for Singaporeans to embrace bike sharing. However, for private bike-sharing companies to be sustainable in Singapore, they need to be very efficient, as profit margins in bike sharing are low.

Tapping Big Data is a way to go about it.

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