ANNEX

A Smart Garden

Gardens by the Bay's Smart Garden vision focuses on three main areas:

- Enable smarter deployment of a skilled local workforce armed with real-time operations and horticultural data
- Streamline processes and reduce reliance on foreign labour through automation
- Improve service quality by leveraging artificial intelligence and machine learning

As part of this vision, the following technologies will be integrated into Gardens by the Bay's existing infrastructure by 2022.

Dashboard

- Data from various areas such as plant monitoring and irrigation, lake management and visitor management will be channelled to a central dashboard for easy visualisation and access. The dashboard is able to trigger alerts for areas that need attention, reducing the manpower required for manual inspection. Staff can customise the areas relevant to their work on a personalised version of the dashboard.

Plant Monitoring and Irrigation

- 75 stations housing hundreds of sensors installed throughout Gardens by the Bay to monitor environmental parameters affecting plants such as temperature, light quality, humidity, soil moisture and salinity. The information is channelled into the dashboard for easy monitoring, and the sensors trigger alerts when any of the parameters are less than ideal.
- Drones conduct autonomous or semi-autonomous scanning of irrigation pipes embedded in elevated areas such as the Supertrees or the Cloud Forest mountain to detect leaks, in order to reduce time-consuming manual inspection.
- Autonomous or semi-autonomous vehicle sprayers spray fertilisers and insecticides in the outdoor gardens, reducing manual labour and costs.

Lake Management

- In the lake system, 15 sensors are installed near various inlet points where water flows in, to identify pollutants that can cause undesirable algae bloom. The information is channelled into the dashboard and the sensors trigger alerts so that staff can take preemptive measures to stop the inflow of such water at the source. This greatly reduces the manpower and cost involved in removing algae bloom that has already set in.

Lighting and Cleansing Management

- More than 300 smart lights installed along the waterfront promenade and boardwalk areas, which are able to turn on and off automatically based on the detection of people, as well as predict potential problems such as power surges and triggering alerts to the dashboard.
- Replacement and consolidation of outdoor waste bins into a smaller number of 30 pest-proof smart bins that can automatically compact contents and detect when bins are full, triggering alerts to the dashboard when emptying the bin is required. This reduces the need for manpower to manually check the state of bins in the outdoor gardens.

- An electrical vacuum sweeper that will progressively become fully automated. Subsequently, through machine learning and artificial intelligence, it can conduct cleansing inspection on its own and detect if cleaning is required. This not only reduces the number of cleaners required on site, but also the need for manual inspection.

Visitor Management

- To reduce the need for traditional "boots-on-the-ground" patrolling, a Centralised Command and Control Centre will allow security officers to monitor via a dashboard various situations around Gardens by the Bay, such as:
    - Real-time crowd density, via CCTVs equipped with advanced video analytic capabilities. A threshold can be set such that alerts are triggered to the dashboard when it is exceeded.
    - Number of people in a specific area via people counter sensors placed at identified entrances.
    - Facial recognition function in key CCTVs will cut down the time required to locate missing persons.
    - Monitor the situation in carparks such as entering or exiting the carpark, flow of vehicles and carpark lot availability.as part of the Integrated Carpark Management System. If a traffic congestion occurs, an alert will be triggered to the Command and Control Centre. Digital signages can also be remotely changed to redirect the traffic to other carparks.
- Automated guardhouses that do not need staffing and can detect the car plate number or IU of a vehicle and allow entry if a request for prior clearance request has been submitted. If ad-hoc entry is required, the intercom links the driver directly to the Centralised Command Centre.
- Automated AEDs run their own checks for example on battery life, and send information to the Centralised Command Centre if there are faults. This reduces the need for manual and time-consuming inspection of multiple AEDs around the Gardens.