

MEng Innovation by Design

2019/2020 Ideate-Prototype-Realize



SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

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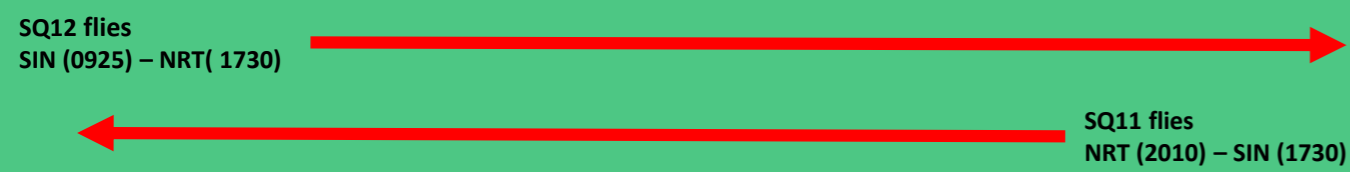
Project: Robotic, Aircraft Interior Cabin Cleaner

WHAT?



Singapore

Narita



- Taking a typical Singapore Airlines flight, between Singapore and Tokyo
- Shown on the right would be the flight pattern
- Where the same aircraft travels between both locations, almost daily

3 forms of cleaning during the different turnaround

- **Turn cleaning**
 - Aircraft will "turn" and fly again.
 - Generally light cleans
 - Trash removal from the cabin and passenger areas.
- **Overnight cleaning**
 - Aircraft that have flown all their routes for the day
 - Remain overnight, generally between 8 to 10 hours
 - Clean is enhanced with a larger focus on the customer areas in and around seats,
- **Deep cleaning**
 - Seat areas and many surfaces are removed and cleaned to expose the inner workings of the seat, compartments,
 - Cabinets and storage areas.
 - Specialized equipment that helps with a deep clean.

WHY?

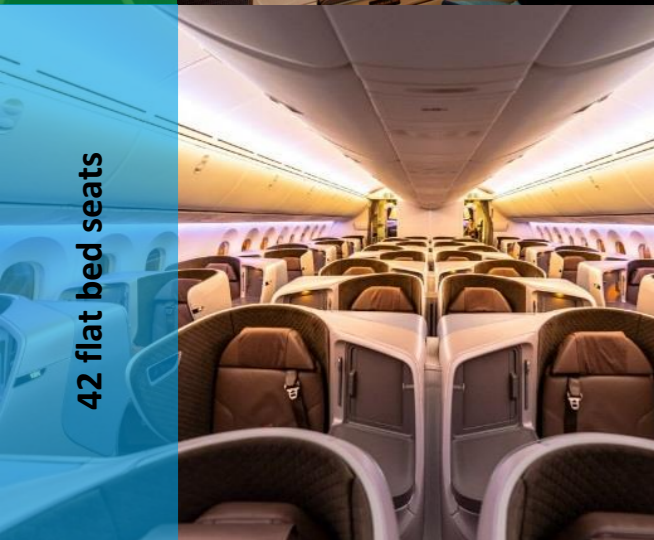


Hazards of the job

- Aircraft cabin - space constraints
- Vacuum cleaner has to be carried (~6kg)
- Aisle width ranges 15" - 18"
- Seat rows ranges 28" - 33"
- Lavatories - 32" - 40"
- Cleaners - constantly in bent and hunched positions still difficult to reach certain areas



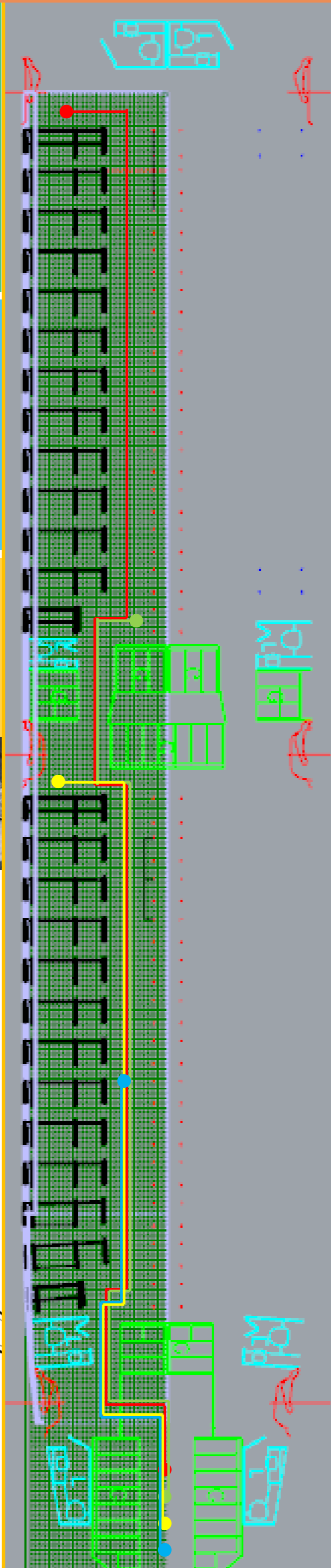
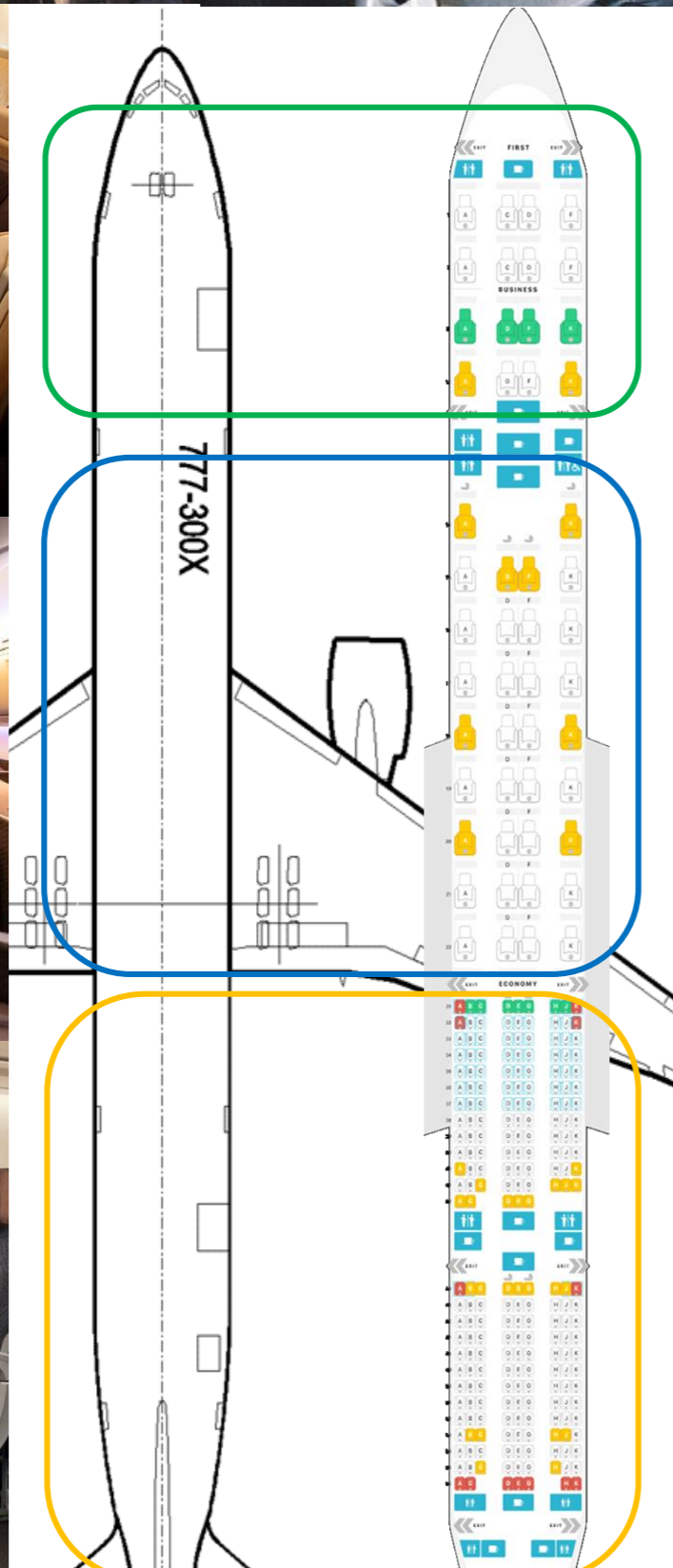
8 flat bed seats



42 flat bed seats



228 standard seats



HOW?

- Under such space constrained condition
- A robot to assist with the cleaning might be the solution to such bad working conditions



1. Intention of this study is to implement a cleaning robot, generated by the "Design by Robot" study. Which allows the robot to fit into as much corners as possible in the aircraft.
2. And then deploy multiple cleaning robots to do the cleaning of the aircraft cabin. For that the intention is to utilize the "Multiple Traveling Salesman" solution.

Study 1 - Stimulated Study of cleaning with optimized robot shape (environment)

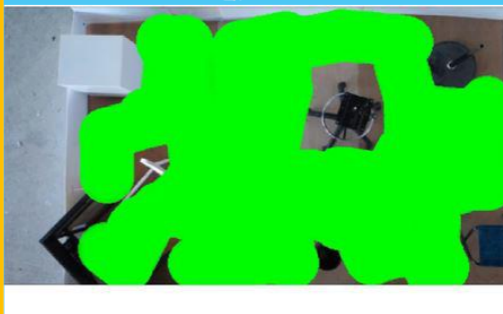


(a)

(b)



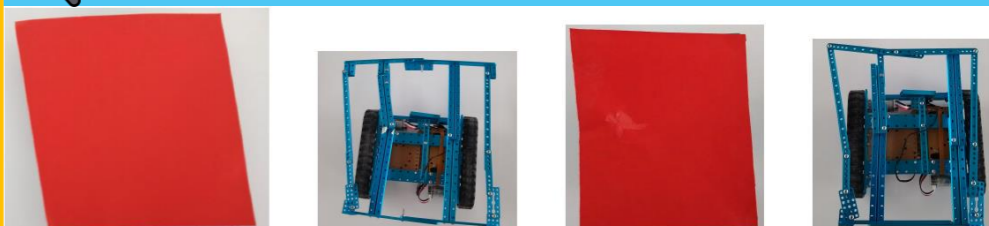
- General cleaning robot - typically circular
- Circular shapes can only clean so much
- Shown in the coverage area in the pictures below



(a)

(b)

- 🔍 Generated optimized shapes as shown managed to cover a much larger coverage
- 🔍 Leaving lesser areas uncleared
- 🔍 As opposed to circular shaped designs



(a)

(b)



Study 2 - Navigation within the Aircraft Cabin

- 📍 Traveling salesman solution
- 📍 Optimizes traveling route of journey
- 📍 Implement multiple cleaning robots
- 📍 Employs multiple traveling salesman solution

