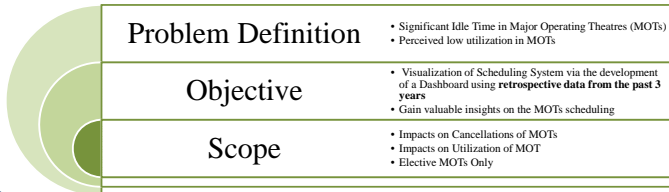


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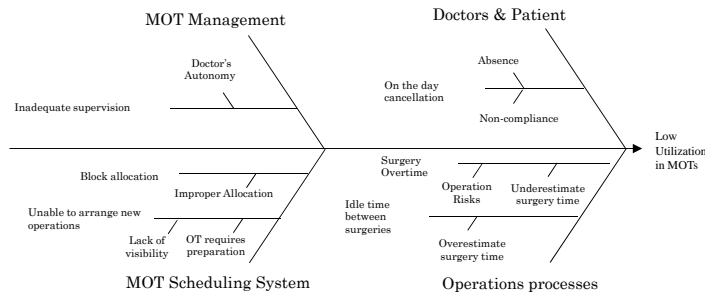
## Company Background

The Singapore General Hospital (SGH) is the first hospital in Singapore opened in 1821. SGH is the largest acute tertiary hospital and national referral centre in Singapore and is Singapore's public sector flagship hospital. SGH is also the largest teaching hospital in Asia and the second largest in the world to be accredited by the Joint Commission International (JCI).

## Problem Definition & Objectives



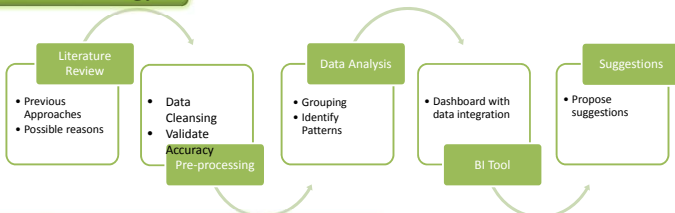
## Root Cause Analysis



## Hypothesis



## Methodology



## Key Performance Indicator (KPI)

- Utilization**  $\frac{\sum(\text{Min}(\text{Patient Exit Time}, \text{Normal Closing Time}) - \text{Patient Enter Time})}{\sum(\text{Normal Operating Hours})} * 100\%$
- Overtime**  $\frac{\sum(\text{Last Patient Exit Time} - \text{Normal Closing Time})}{\# \text{ of working days}}$
- Operation time deviation**  $\text{Scheduled operation length} - \text{Actual operation length}$
- Nominal Cancellation**  $\text{Length of scheduled operations being cancelled}$
- Absolute Cancellation**  $\text{Length of scheduled Operations being cancelled without replacement}$

## Conclusion

This project provides valuable insights on the MOT scheduling system. According to the Dashboard, Cancellation and Overtime as well as other factors are proved to have certain impacts on MOT utilization. In addition, future research could be done on measurements to be implemented to further improve the management of the scheduling system.

## Acknowledgement

The team would like to express our heartfelt appreciation to SGH for providing the research opportunity. We would also like to thank Dr S. W. Lam, Ms R.L. Mohanavalli and Mr F.L. Hoang for their time and precious feedbacks. Last but not least, we would like to express our deepest gratitude to Prof. L.H Lee and Prof B. Huang for their kind help and guidance.

## Dashboard Features



Figure 1. Utilization of different MOTs

Figure 1: This dashboard features the utilization of different MOTs during the week. A spectrum of colors are used to represent the level of utilization from low (red) to high (green). Dashboard also features a graphical representation of the utilization of different MOTs over the different days of the month. Across the years, the utilization in January and December are generally low. This aids the MOT management to monitor the utilization of all MOTs at a glance conveniently.

Figure 2: This dashboard compares the total absolute cancellation time hours per day against the MOT's daily utilization. Thick lines represent high absolute cancellation hours while the peaks represent the daily utilization rate. Absolute cancellation reduces daily utilization for some cases. Yet, there are instances observed that high utilization despite high absolute cancellation. This is mainly due to the replacement of the cancelled slot.



Figure 2. Utilization and Cancellation

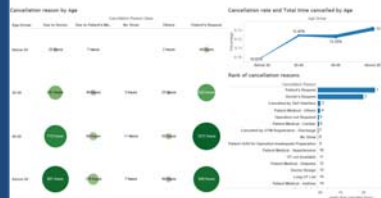


Figure 3. Cancellation reasons by age group

Figure 3: This dashboard depicts the nominal cancellation rate for patients of different age groups. Overall patients that are above 60 have a 30 percent chance to cancel their operations appointments as compared to younger patients. Patient's Request ranks the top for the reasons of cancellation followed by Doctor's Requests.

Figure 4: This dashboard reveals the actual length of time (represented by the boxplot) compared to the average scheduled length of time for different operating procedure (represented by the orange bar). Overall for most of the procedures, the scheduled time to perform the procedure is generally shorter than the actual time to complete the procedure.

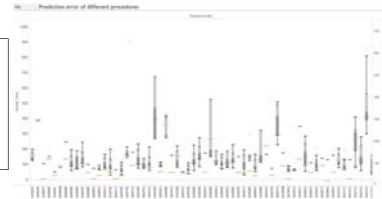


Figure 4. Actual Operation Length Vs Scheduled Operation Length

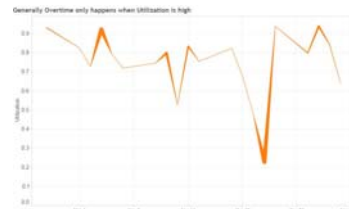


Figure 5. Utilization and Overtime

Figure 5: This dashboard displays the Overtime (thickness of line) compared to its utilization (the peaks). Overtime generally occurs during high utilization. Yet, some outliers have been observed. Utilization can be low whereas overtime can be high if the MOT is utilized beyond operating hours.

Figure 6: This dashboard depicts the average operation time breakdown for different MOTs in SGH. The breakdown for every operation perform on a patient is broken down into:  
 1. Induction time  
 2. Pre-Operation time  
 3. Session time  
 4. Post-Operation time



Figure 6. Average Operation Time Breakdown

## Results and Recommendations

- Proper communication between doctors and patients to reduce cancellations
- Improve flexibility in rescheduling to achieve high utilization
- More supervision on the scheduling system to keep track on the status of MOTs
- Comprehensive guideline for operation length prediction
- Administrative policies to relieve seasonal cancellation (during December and January)