IE3100R SYSTEMS DESIGN PROJECT GROUP 17

HOSPITAL OPERATING THEATRE ROOM (OTR) DASHBOARD

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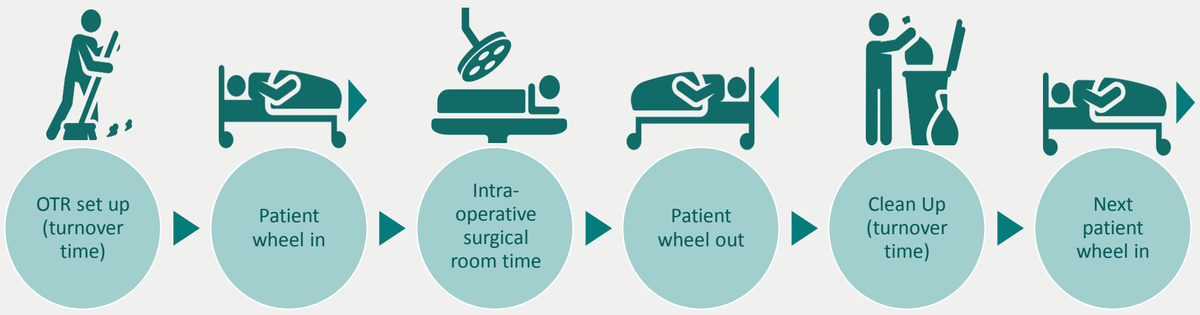
INTRODUCTION

With the increased demand on clinical service quality and rising operating cost, greater emphasis must be put on the optimization of the operation theatre rooms' performances in order to ensure a successful and high-standard operation. In our project, we helped the hospital to develop an intelligent dashboard tool that will provide comprehensive monitoring for the operations team to track the situation on the ground, and hence to make informed decisions to improve the efficiency of the operation theatre rooms.

OBJECTIVES

- **Accurate Measurement**
  KPIs through data automation process
- **Easy Monitoring**
  Performance across multiple benchmarks
- **Empowered Improvement**
  Management of Operating Theatre Rooms

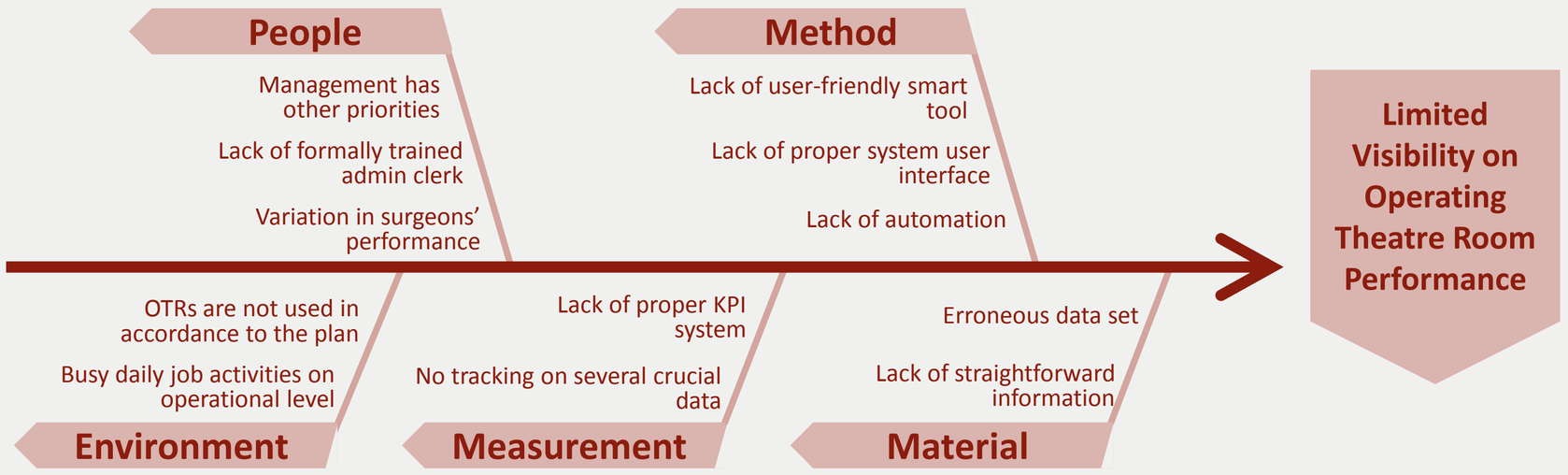
OPERATING THEATRE ROOM WORKFLOW



APPROACH

1. Root cause analysis
2. Data Analysis
3. KPI concepts
4. System Design
5. Implementation

1. ROOT CAUSE ANALYSIS



2. DATA ANALYSIS

OT Reservation

- Identified potential problem associated with high absentee rate (31% of patient do not show up on the reserved date).
- Identified reservations with long waiting time (6% of the patients need to wait more than 12 weeks).

OT Reporting

- Identified OTR with unusually low utilisation rate with Pareto Chart (2.5 Sigma below mean utilization rate).
- Identified possible systematic surgery prediction bias (average + 38.5 mins and 83% of data points lie within positive region).

Both Data

- Identified and documented erroneous data set with its respective causes and resolutions.
- Identified systematic human errors in data collection arising from the misuse of the hospital's recording system.

3. KEY PERFORMANCE INDICATORS

To understand the situation on the ground, we proposed 4 KPIs (Key Performance Indicators). They provide an overview and empower hospital management to monitor and evaluate the performance of the OTRs.

Utilization Rate
Are the available Operating Theatre Rooms properly utilised?

Surgery Prediction Bias
Are surgery durations estimated accurately?

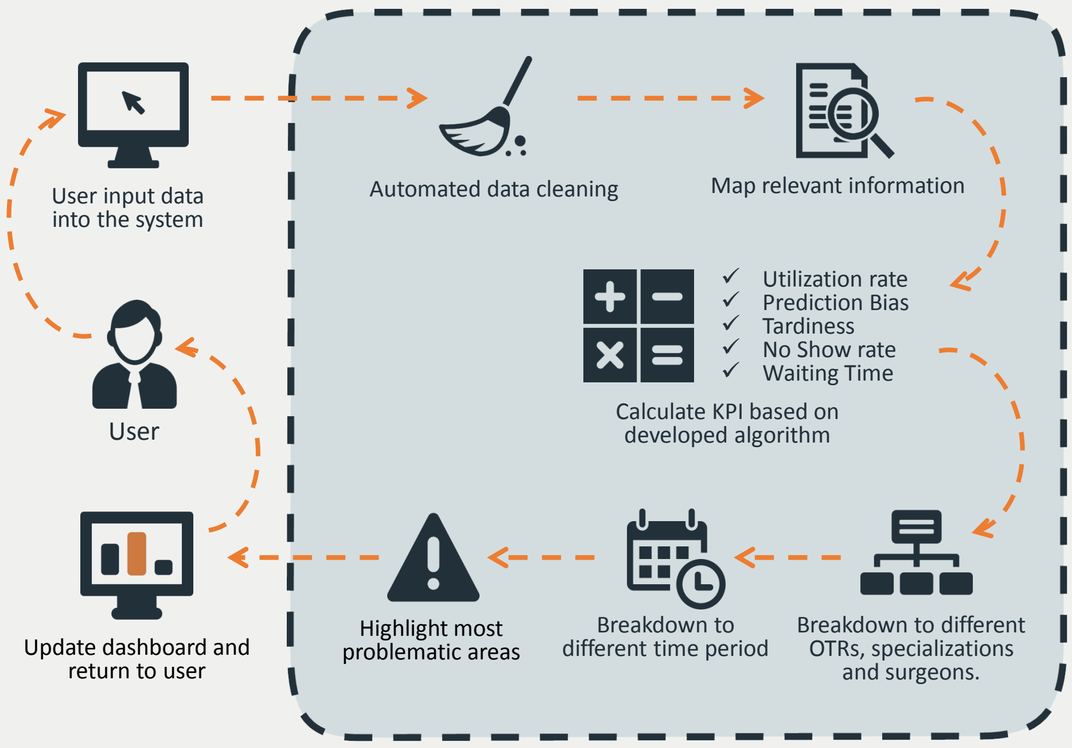
Start Time Tardiness
Do surgeries start on time?

No-Show Rate
How many of the scheduled surgeries are fulfilled?

Elective Waiting Time
How long a patient wait to have an elective surgery?

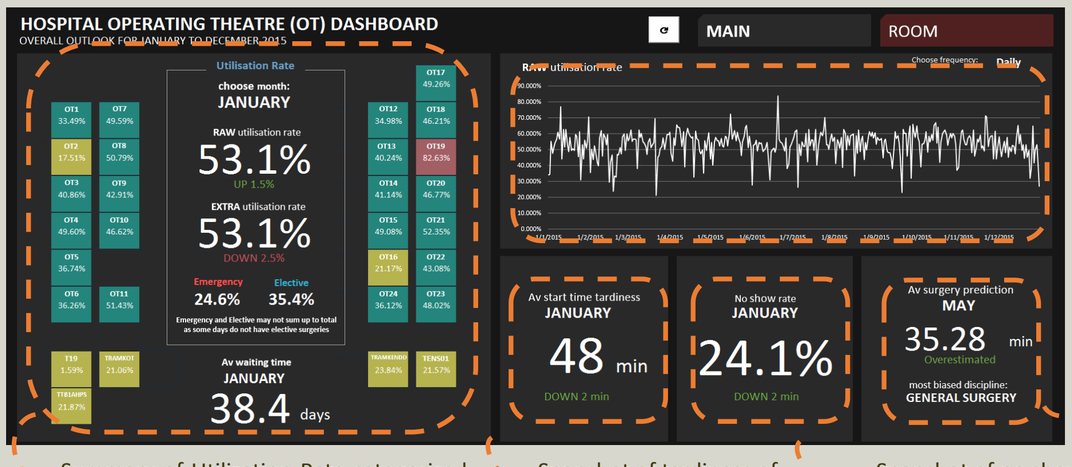
4. SYSTEM DESIGN

After we understood the root problems, analysed the data, and identified the key KPIs, our next step was to design and build a system that would take in the raw data set, analyse and perform various functions automatically in Excel VBA. We took into account the human errors nested within the data set and eliminated them accordingly to deliver the most accurate representation of the OTR performance.



5. IMPLEMENTATION

Main OTR Dashboard shows the main information of each KPI



Utilization Rate (UR) trend categorized by time period (daily, weekly, monthly)

Snapshot of surgery prediction bias of chosen month

Summary of Utilization Rate categorized by time period, room, and surgery type

Snapshot of tardiness of chosen month

Snapshot of no show rate of chosen month

Room Dashboard shows more detailed information for each OTR

Different KPIs for each OTR

Utilization breakdowns to different disciplines

X-MR control chart with k=2 is used to monitor the variation in Utilization Rate for each OTR. Categorized by the type of surgery (elective/emergency)

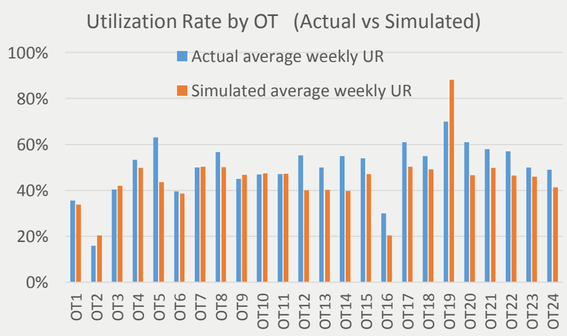
Our dashboard user interface is optimized to meet the need of the management. We adopted various Human Factor Engineering theories to maximize the dashboard usability by presenting the data in a concise, easy-to-read and visually attractive manner. Moreover, we also included several control charts to monitor the variations in OTRs' utilisation rate. Other than the Main and Room dashboard, we also provided a detailed dashboard for each of the Key Performance Indicators.

FUTURE DIRECTION

Simulation Model is used to empower Operating Theatre Rooms' operations in the future. Base model was built based on Year 2015 historical data. 24 Main Operating Theatre Rooms, 7 levels of Surgery Complexity and 13 Clinical Disciplines are simulated in the base model. The simulation was a 7-day terminating simulation as weekly utilization rates are more stable than daily utilization rate. 53 replications were run which are more than the required R for the predetermined precision.

Average surgery durations for different severities and disciplines which are approximated by using regression modelling follow exponential distribution.

Model Validation



Possible future improvement

Proposal 1: Allocate more elective surgeries to OT16 to fully utilize all resources.
Proposal 2: Schedule Nuerosurgeries to OT1 and OT3 alternatively to make sure there is at least one room up for Emergency Nuerosurgeries during resource hours. This will free up OT2 for other emergency surgeries during 8am to 9pm

Below is the effect on the UR of each proposed solution simulated.

Proposal	Effect on other OTs' UR	Effect on OT16 UR	Effect on OT2 UR
1	Up 1.1%	Up 15%	No observable effect
2	Up 1.4%	No observable effect	Up 8%