Leveraging Data Analytics In Systems Engineering –

Towards A Quantum Leap in Railway Reliability

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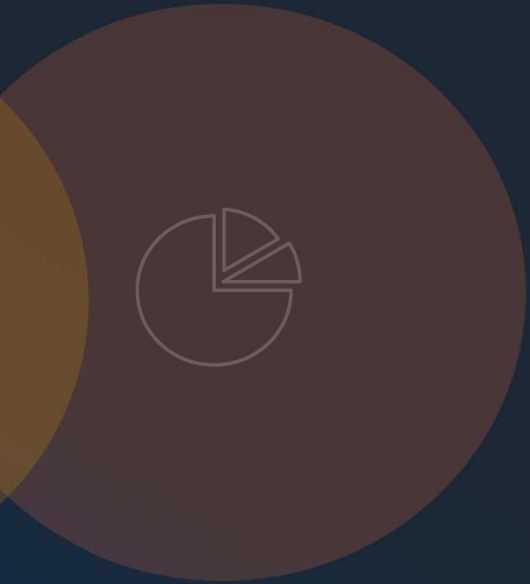
AGENDA

INTRODUCTION   **OBJECTIVE**   **HOW & WOW**   **CONCLUSION**
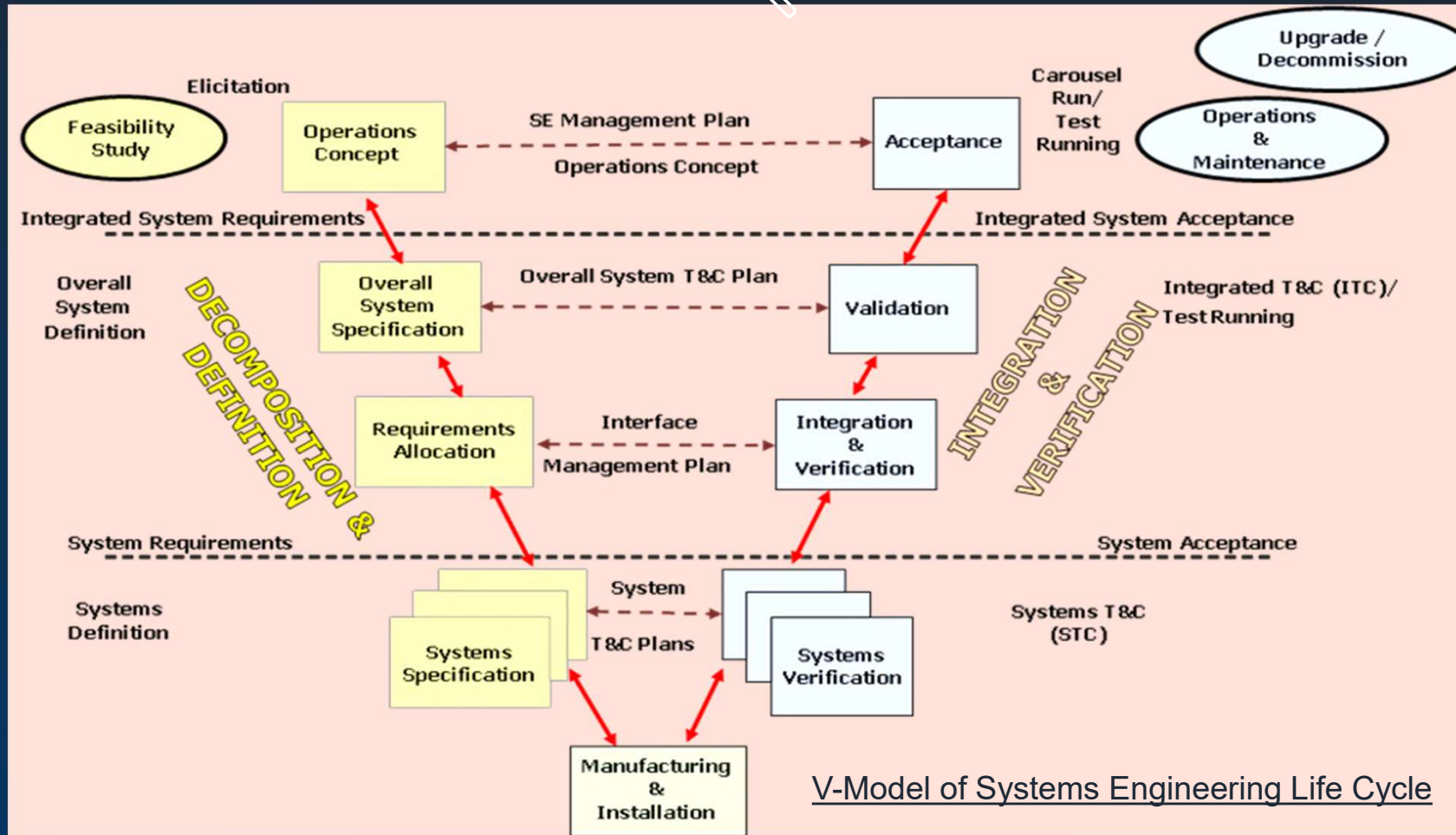
AGENDA

INTRODUCTION

OBJECTIVE   HOW & WOW   CONCLUSION

INTRODUCTION
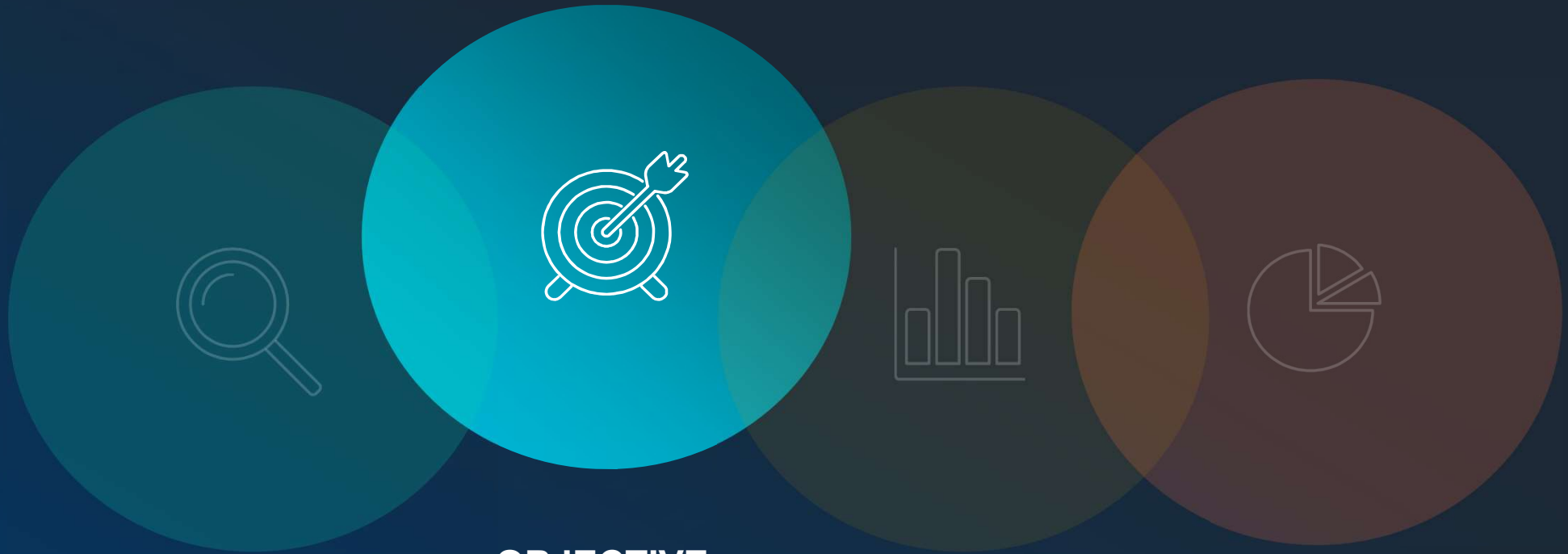

V-Model of Systems Engineering Life Cycle

INTRODUCTION

Systems Engineering Life Cycle

V-Model of Systems Engineering Life Cycle

Need for accurate, timely, accessible information about systems

Need to cover over 60,000 operating assets

Need for understanding of asset behavior and performance
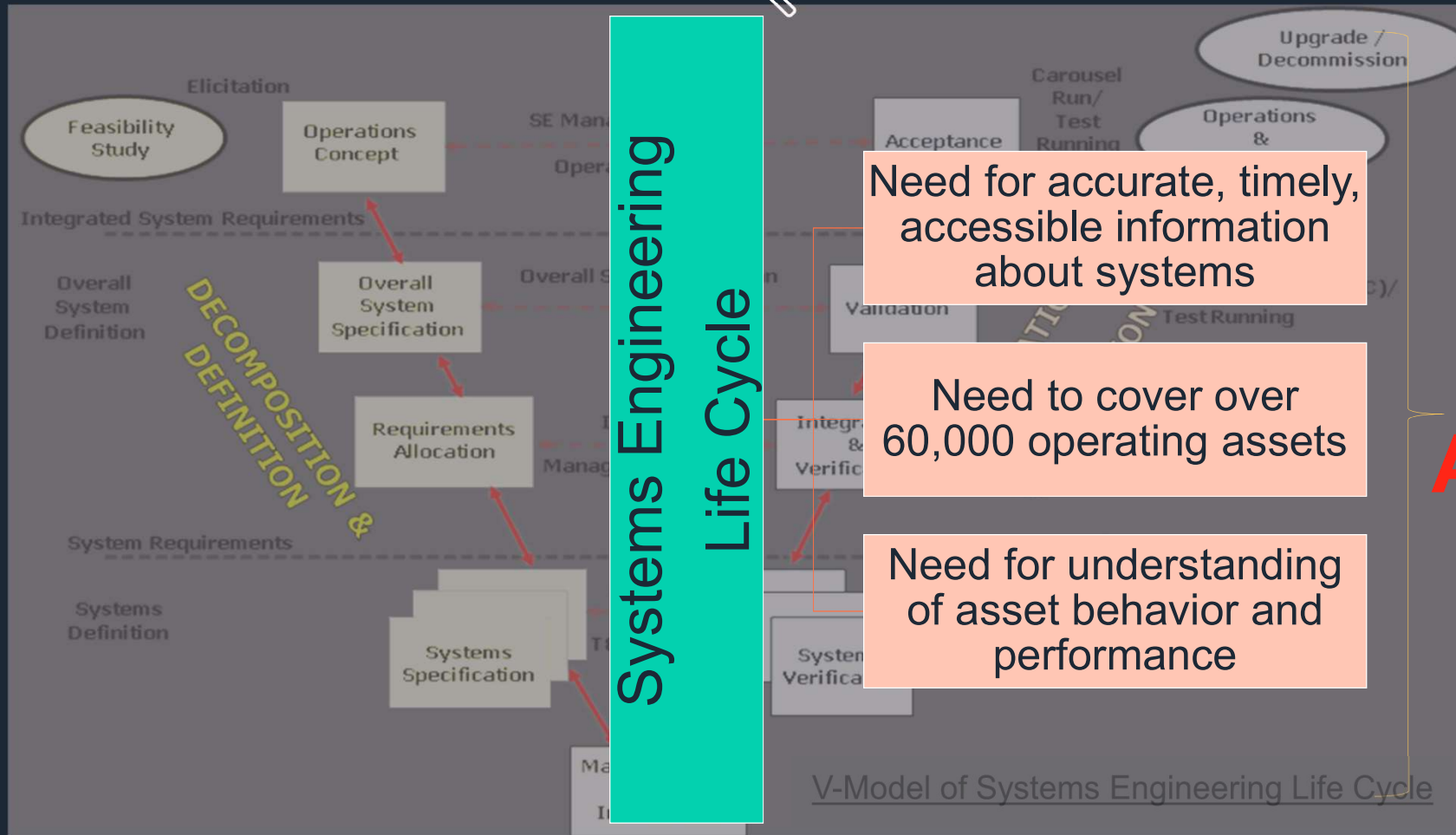
Data Analytics

AGENDA

OBJECTIVE

INTRODUCTION   HOW & WOW   CONCLUSION

OBJECTIVE

200,000 MKBF	400,000 MKBF	1 Million MKBF
2016	2018	2020

Singapore's RTS Reliability Milestone Targets

OBJECTIVE

Target Reliability of 1Million MKBF

Identify areas of concern

Illustrate use of Data Analytics on sample performance data

RELIABILITY

Fault Counts by Locations and System

Fault Counts by Locations

HOW & WOW

HOW & WOW

INTRODUCTION   OBJECTIVE   CONCLUSION

HOW & WOW

Receive raw data

Run script to clean up raw data

Store cleaned data in warehouse server

Analyse data trending workbook via Tableau
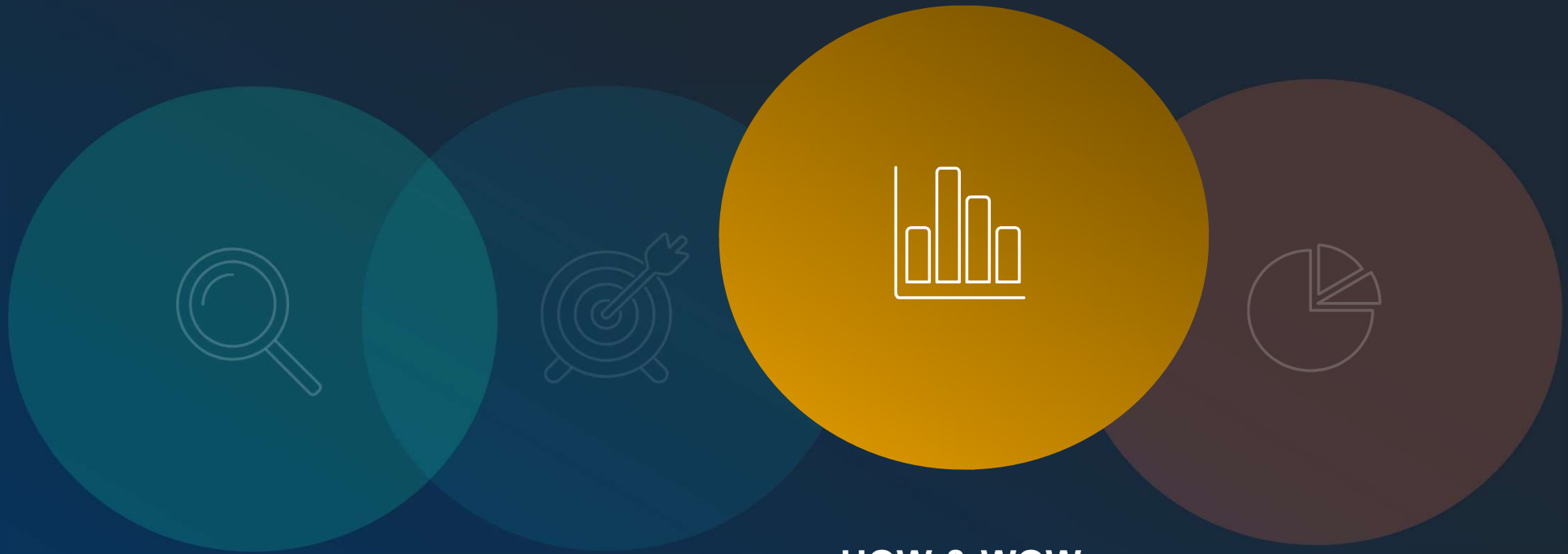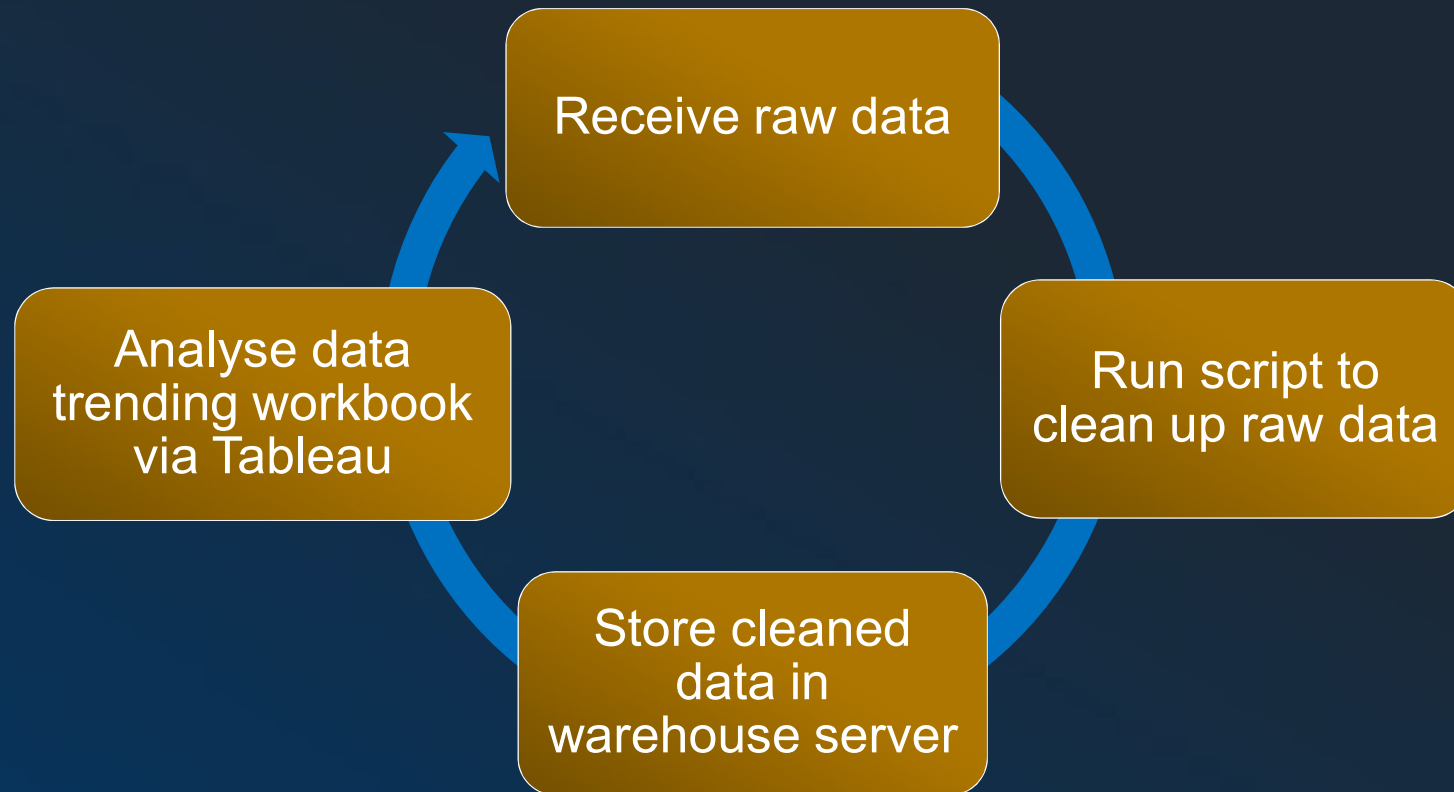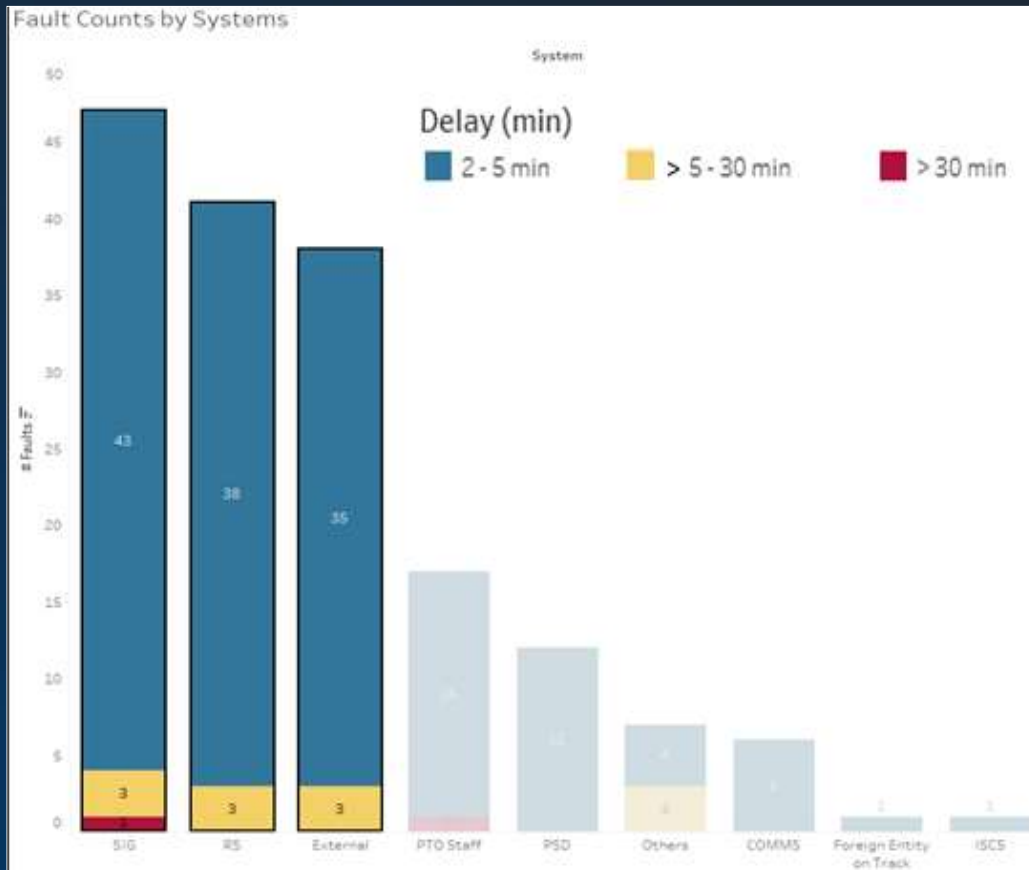
Data Cleaning Cycle

HOW & WOW

Failure Count by Systems

- Further analysis to appreciate observations using the same data set

- Key operation parameters include Location (Trackside/Station), PV number, Sub-system failure count & Peak/Off Peak Hours

- Customised trends are automatically generated using data visualization tools
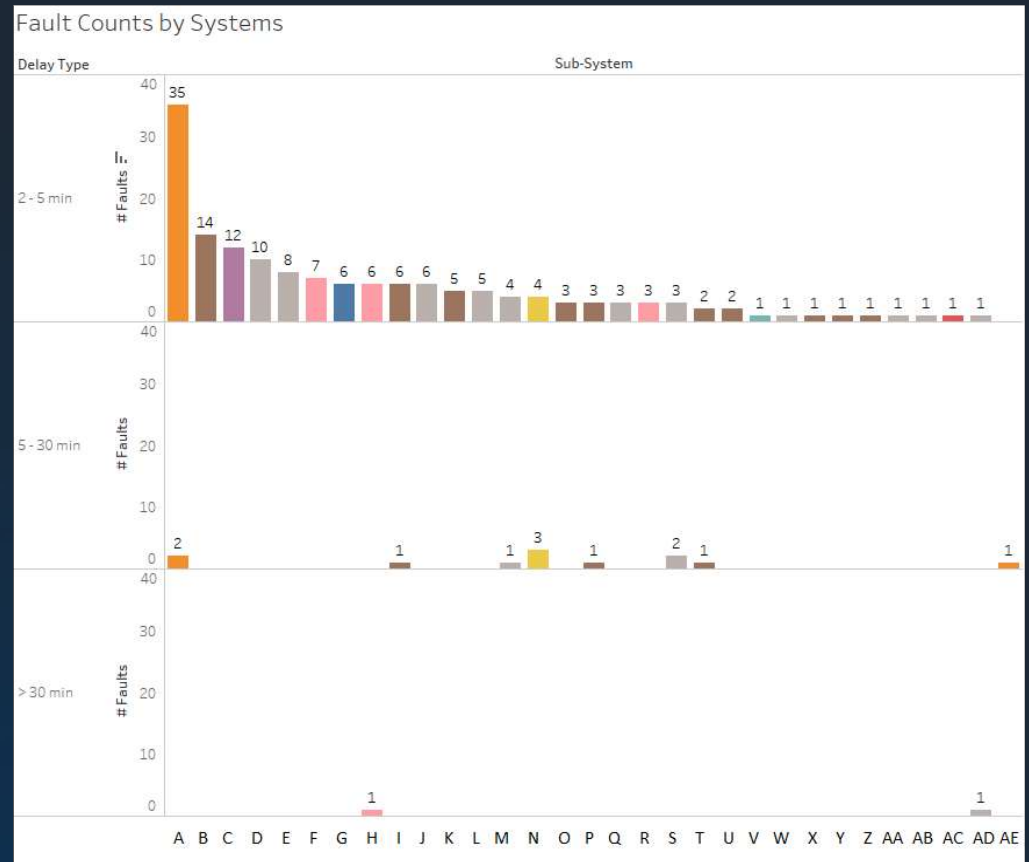
HOW & WOW

- Data can be analysed at a higher level of granularity

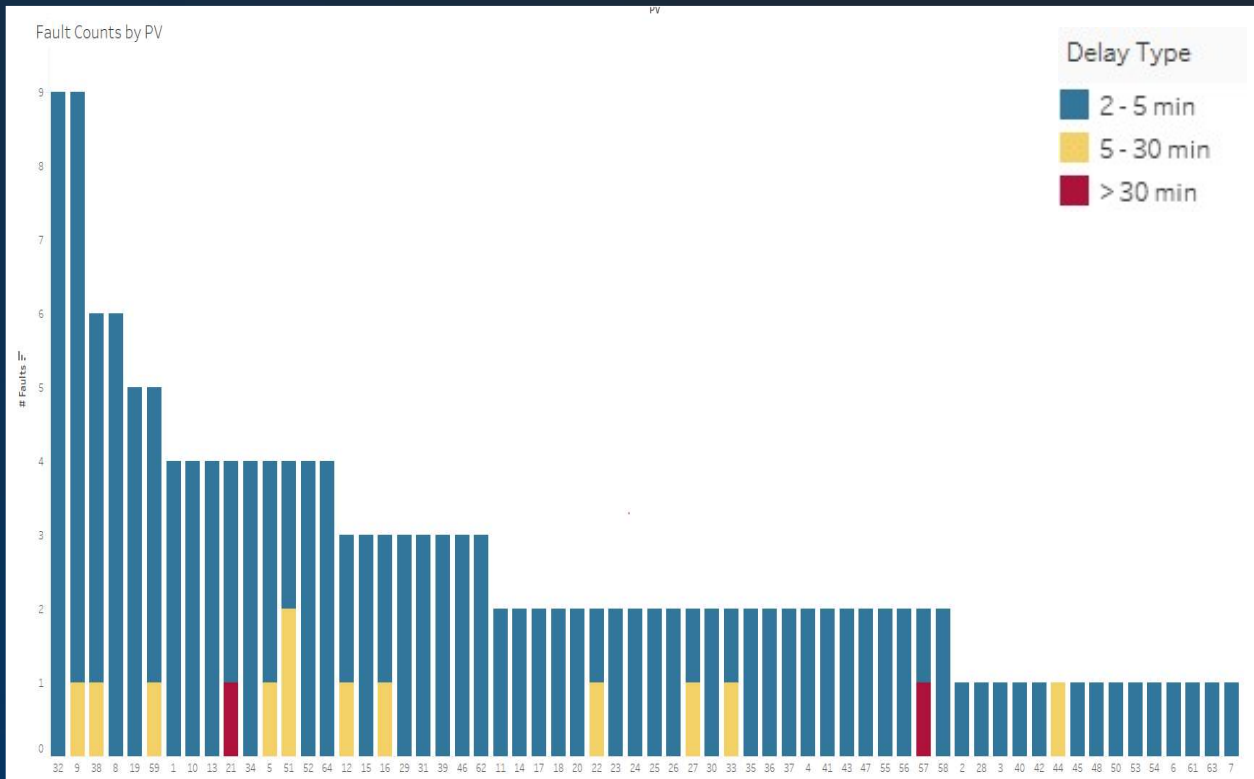- Such analyses reveal emerging symptoms of other delays or more severe delays

- Figure demonstrates that failures of some modules in the 2 to 5 min categories could have indeed led to 5 min delays

Fault Counts by Systems

Failure Count by Sub-Systems

HOW & WOW

Fault Counts by PV

Failure Count by PV

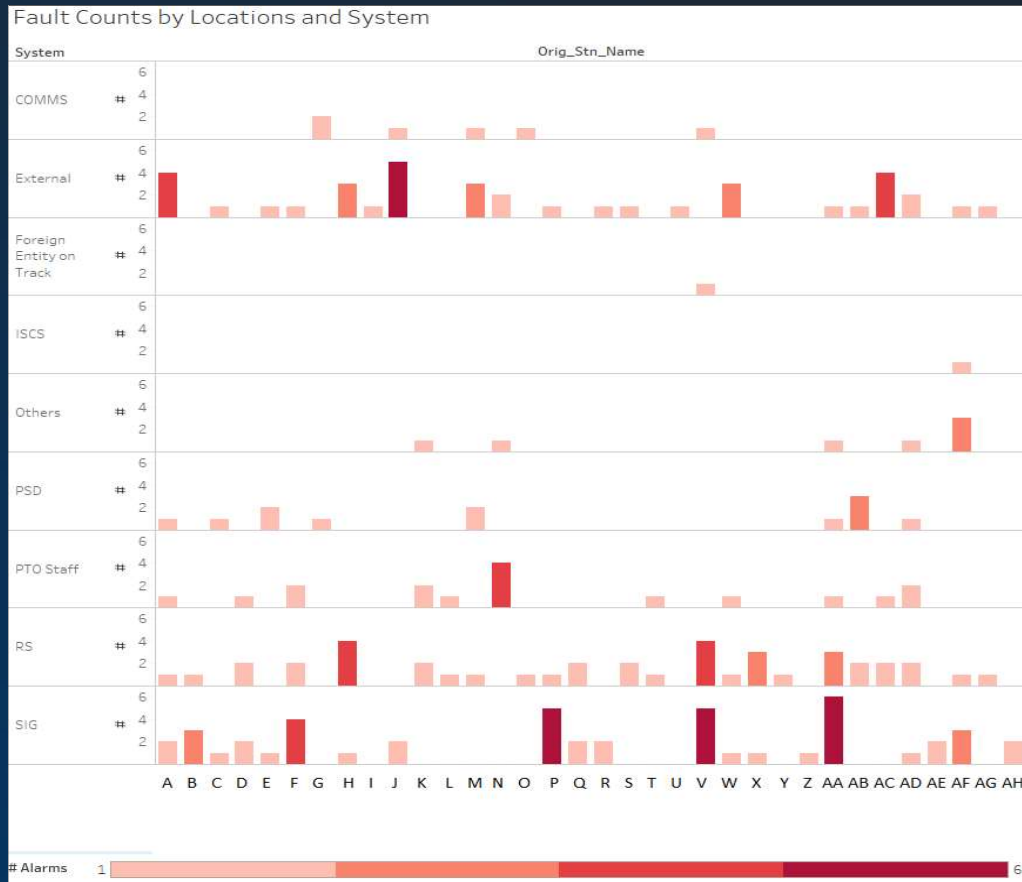- Analysis can be carried out on a particular system of interest

- Figure shows there is no specific PV (Passenger Vehicle) with particularly high failure rate, the max no. of counts was 9

- No clear positive relationship between 2-5min delays and >5 min delays

HOW & WOW

- Multi-dimensional trends can also be plotted to validate interfacing factors

- PV fault count was plotted against location (train stations) to see their correlations

- Failure distribution appears to be quite random, with a specific PV failing at a specific location at most, twice

Failure Count by PV at Specific Location

HOW & WOW

Fault Counts by Locations and System

System Failure – Location Distribution

- System failures were plotted against location

- Results showed that Signalling failures were more prevalent at Stations F, P, V and AA (at least 4 counts)

- This could possibly point us to investigate further why these locations exhibited higher Signalling failures than others
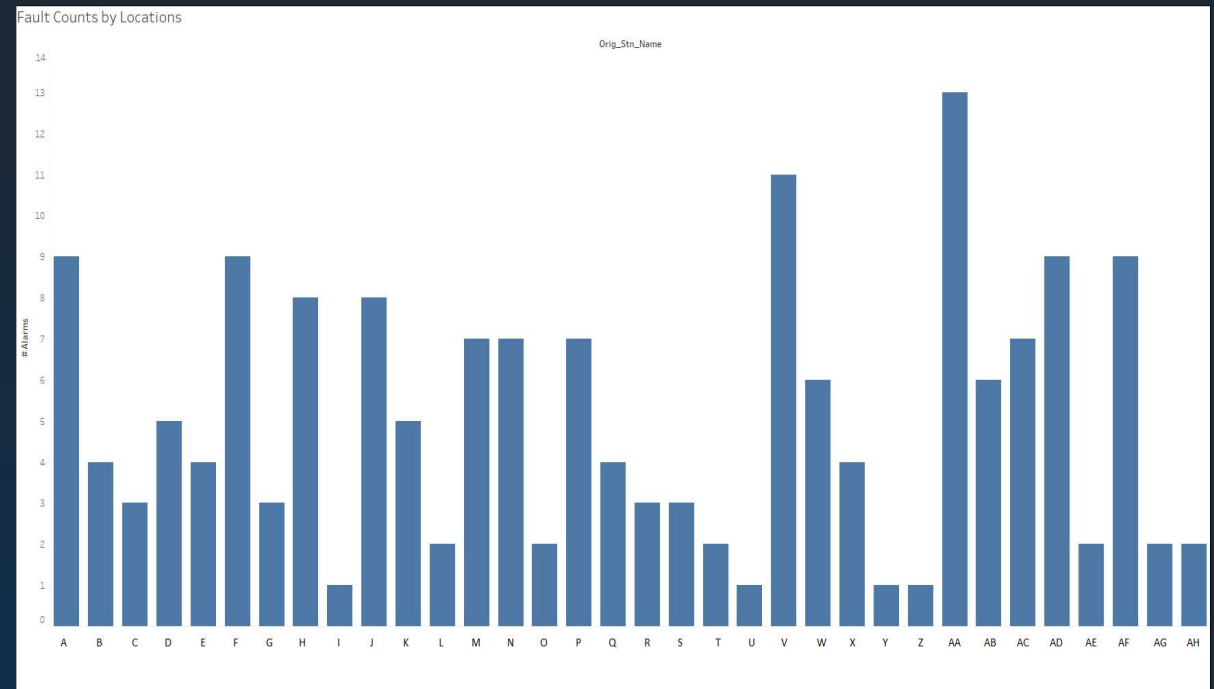
HOW & WOW

- Trends can also be plotted based on connectivity between stations in the network

- Results possibly showed higher concentration of failures at interchange stations or stations known for heavier human traffic
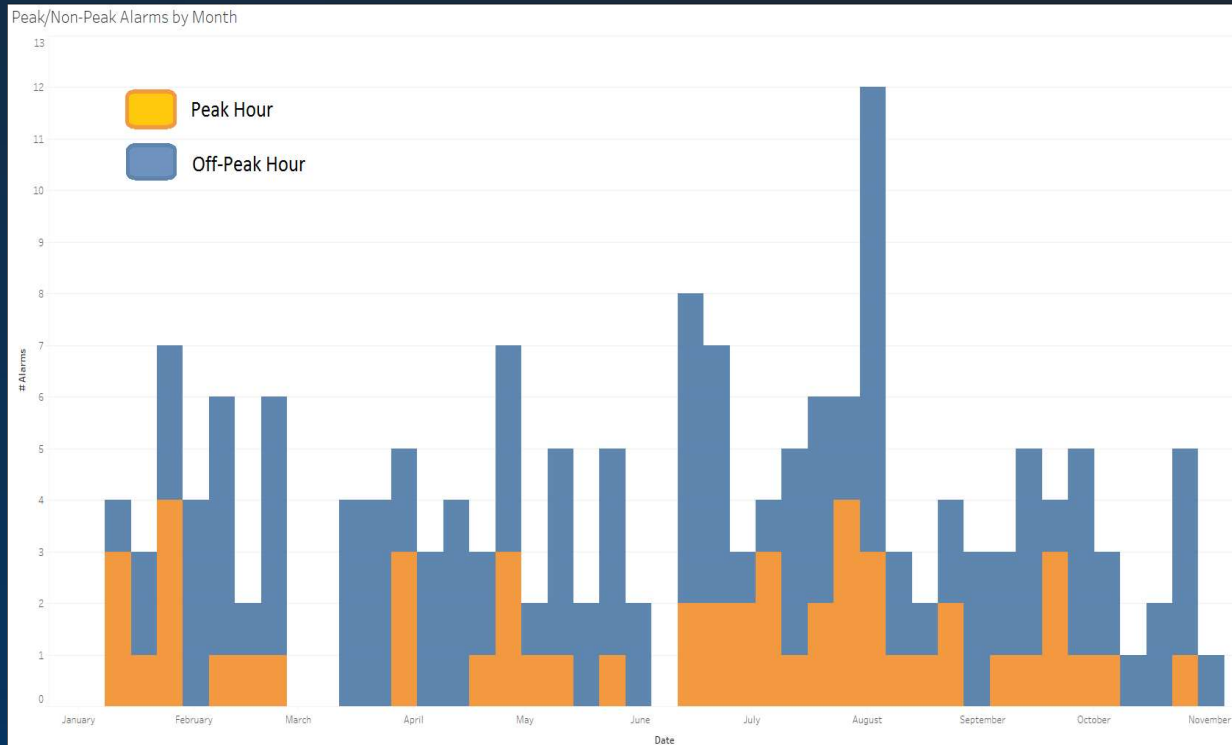
- Failures due to heavier loading on system is a possibility; ie loading could be critical to asset health

Fault Counts by Locations

Failure Count - Location (In Sequence) Distribution

HOW & WOW

Peak/Off-peak Hour Failure Distribution

- Data was analysed comparing failures between peak and off-peak hours

- General correlation between hours covered and failures

- More failures did not necessarily occur during peak, though more studies and data could be included for more concrete findings

AGENDA

CONCLUSION

INTRODUCTION OBJECTIVE HOW & WOW

CONCLUSION

Challenges

Data Integrity
- Data could be incomplete or inaccurate
- Especially when human or manual input is required

Technical Capability
- Ability to harness the use of data analytics
- Skill to discern what is useful and what is not

Domain Knowledge
- Sufficient technical experience to discern actual correlations
- Particularly when there are coincidences

CONCLUSION

Better information on system vulnerabilities

Better predictions on incoming failure; earlier improvement activities

World Class standards in Railway

Data Analytics In Systems Engineering

Better strategies to operate, maintain, modify and upgrade

Better feedback for design improvement and new project baselines

THANK YOU