Team No:- 22

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"Autonomous Vechicles"

1 : Crystallizing Problem Statement

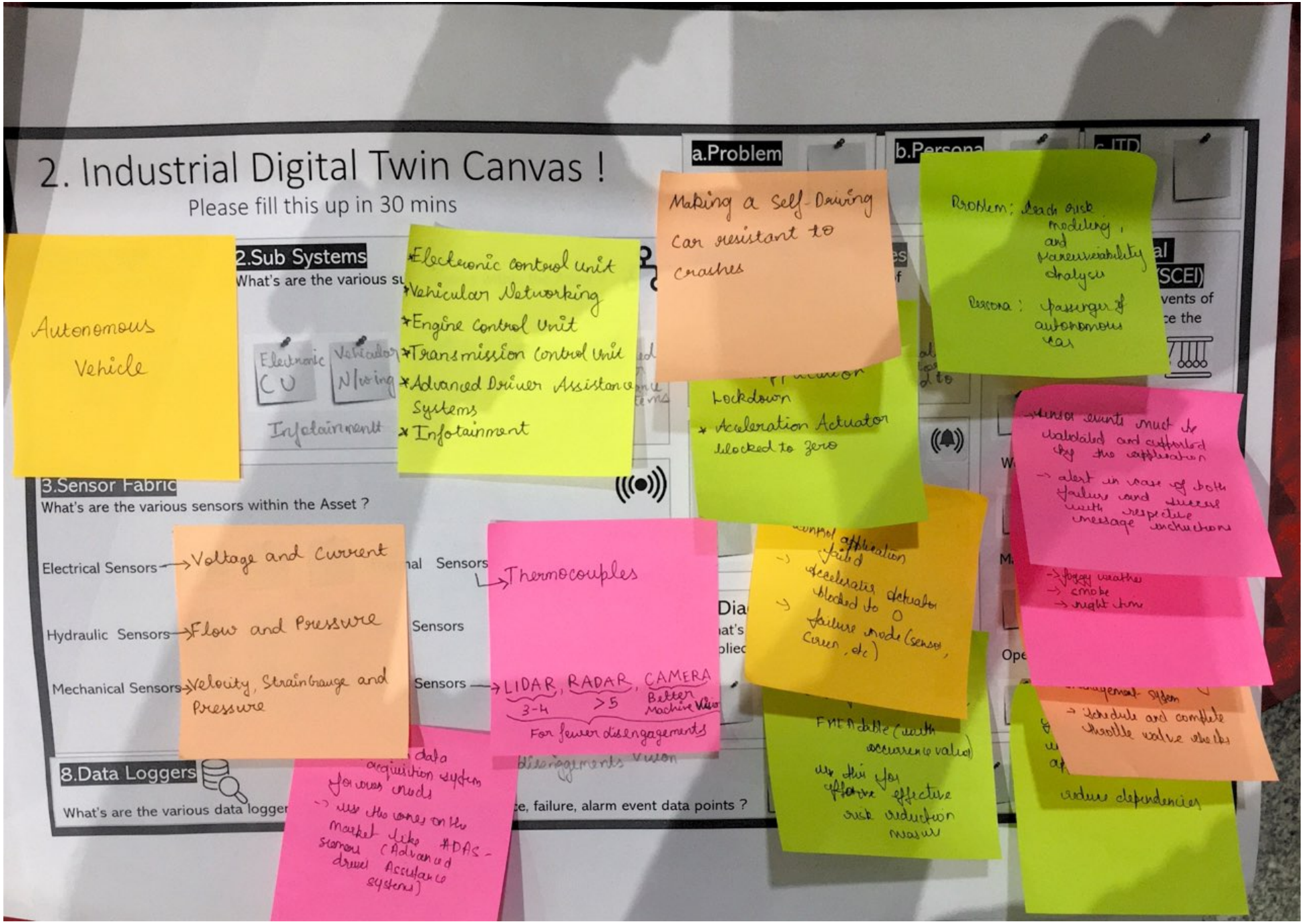
(What keeps you awake at night ?)

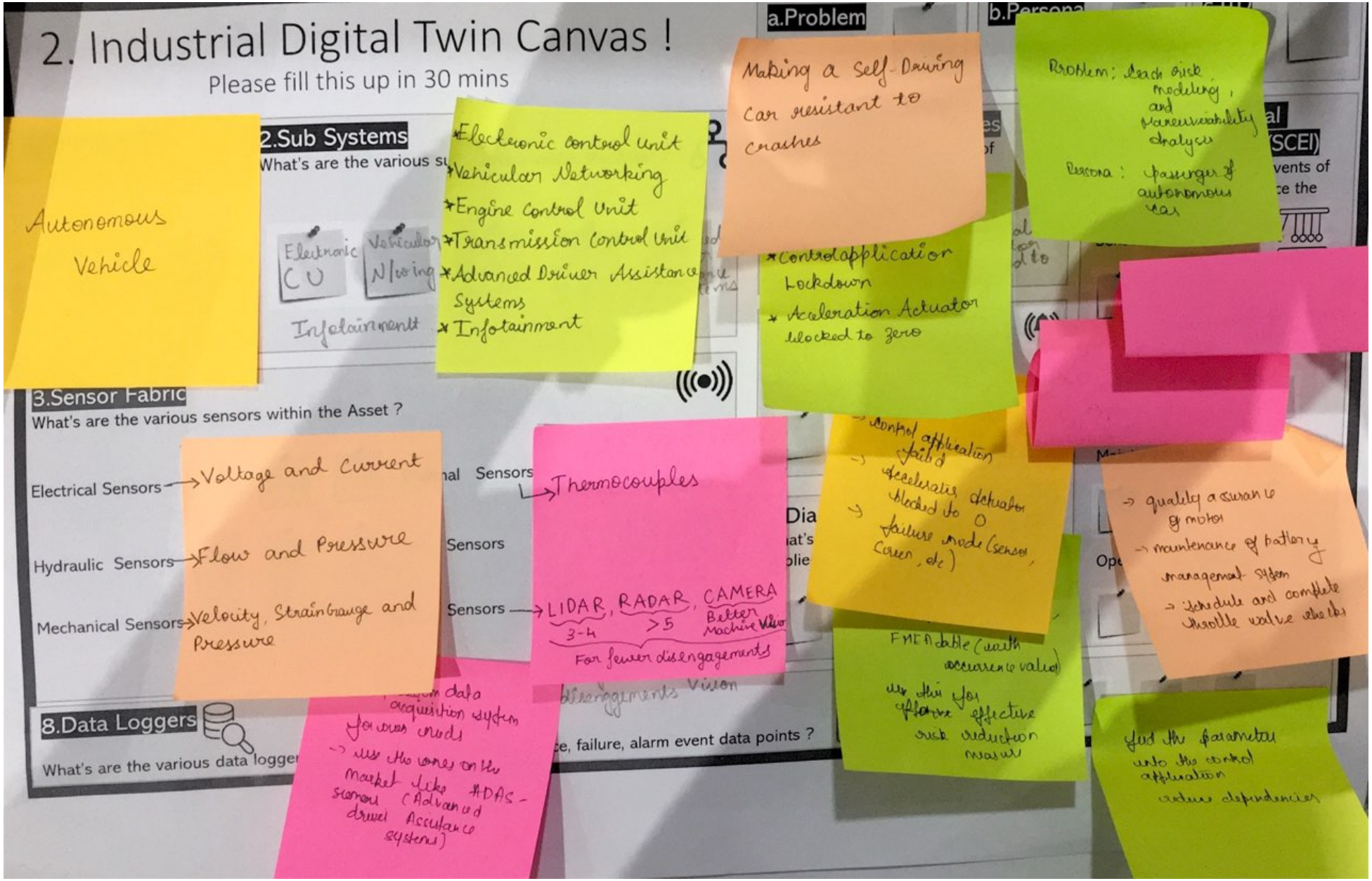
Crash Risk modelling and manuverability Analysis

- **PERSONA =** Passenger *(Thru whose eyes are you experiencing the problem ?)*

- **My unsolved problem is** Making a self-driving car resistant to Crashes
- This is keeping me awake at night and important to solve because _____ *(Whats the impact ?)*
- We need to improve _____ from _____ to _____
- The current issues I am encountering are
  - Rear-End and side swipe Crashes
  - Weather condition that affect visibility and control for both AV and neighbouring vehicles
  - Uncertainity in the behaviour of neighbouring vehicles
- If I solve this problem the
  - The minimal case $ impact is 230 Billion dollars [Report by intel]
- The human impact of solving this problem is 600,000 thousand lives
- This is among the top 5 problem to solve this year

"A problem clearly stated is a problem half solved."
Dorothea Brande (1893 - 1948)


2. Industrial Digital Twin Canvas !
Please fill this up in 30 mins
Autonomous Vehicle
2.Sub Systems
What's are the various su
Electronic C U
Vehicular N/w ing
Infotainment
*Electronic control unit
*Vehicular Networking
*Engine control Unit
*Transmission control Unit
*Advanced Driver Assistance Systems
*Infotainment
3.Sensor Fabric
What's are the various sensors within the Asset ?
Electrical Sensors → Voltage and Current
Hydraulic Sensors → Flow and Pressure
Mechanical Sensors → Velocity, Strainbrauge and Pressure
nal Sensors → Thermocouples
Sensors
Sensors → LIDAR, RADAR, CAMERA
3-4 >5 Better Machine Vision
For fewer disengagements
8.Data Loggers
What's are the various data logger
ce, failure, alarm event data points ?
data acquisition system for cross checks
-> use the ones on the market like ADAS - sensors (Advanced driver Assistance systems)
a.Problem
Making a Self-Driving Car resistant to crashes
Lockdown
* Acceleration Actuator blocked to zero
b.Persona
Problem: Crash risk modeling, and Vulnerability analysis
Persona: Passenger of autonomous car
Sensor events must be validated and authorized by the application
-> alert in case of both failure and threat with respective message instructions
-> foggy weather
-> smoke
-> night time
control application failed
-> Acceleration Actuator blocked to 0
-> failure mode (sensor, Camera, etc)
FMEA table (with occurrence value)
use this for effective risk reduction measure
-> schedule and complete throttle valve checks
reduce dependencies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*Control application Lockdown
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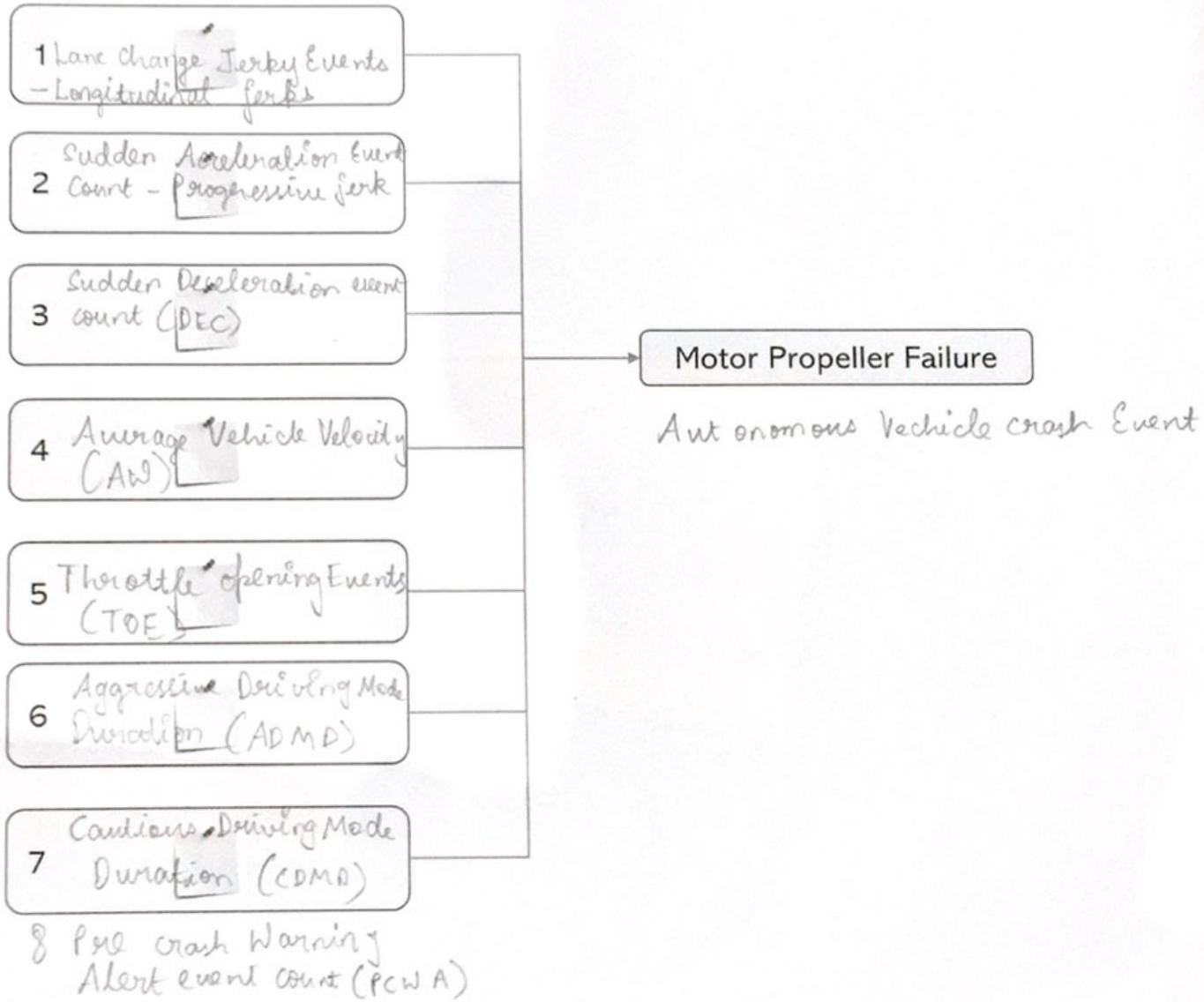
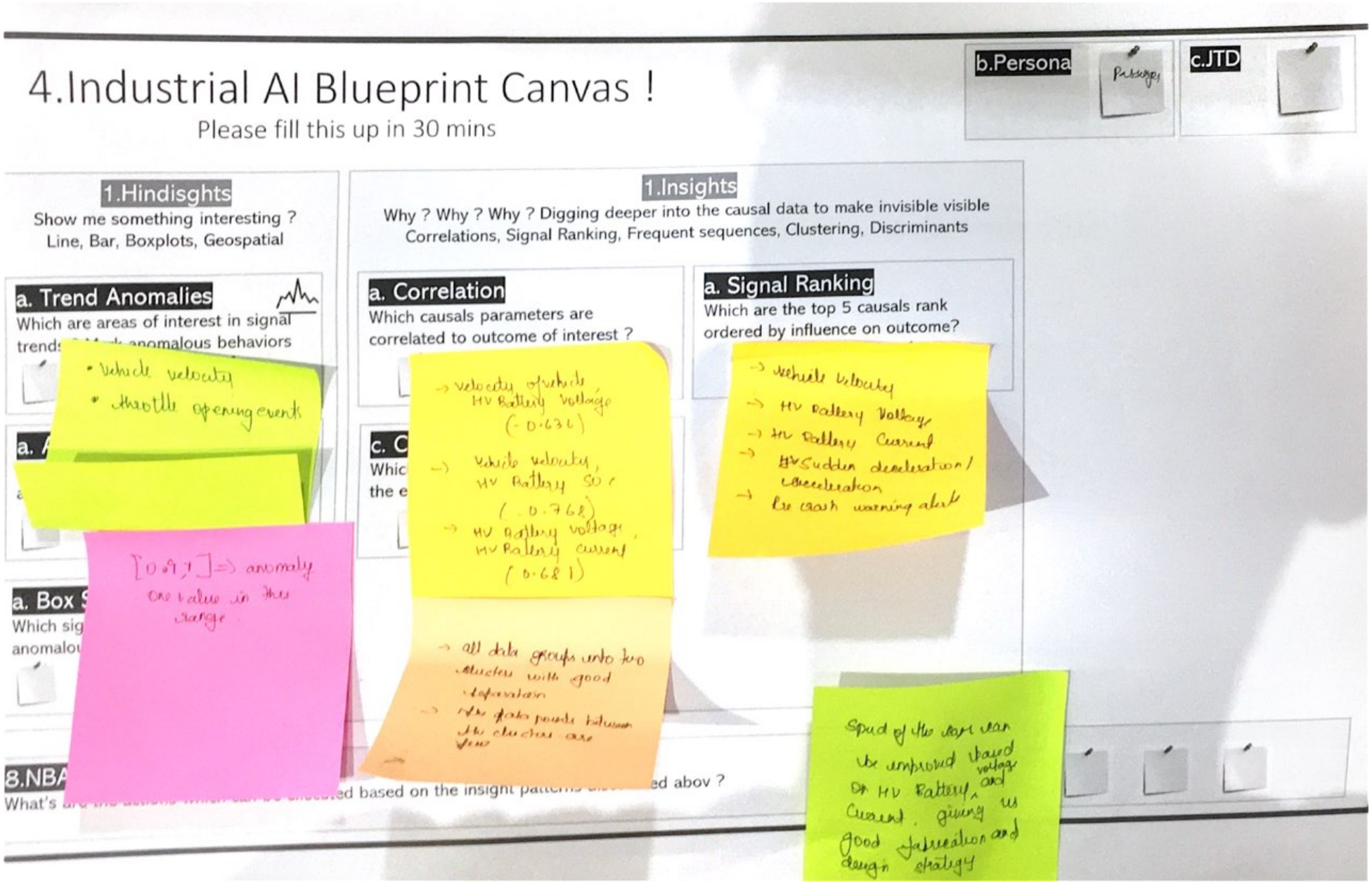
3-4 >5 Better Machine Vision
For fewer disengagements
Vision
8.Data Loggers
What's are the various data logger
ce, failure, alarm event data points ?
FMEA table (with occurance value)
use this for effective risk reduction measures
→ quality assurance of motor
→ maintenance of battery management system
→ schedule and complete throttle valve checks
feed the parameters into the control application
reduce dependencies

3. Causal Map

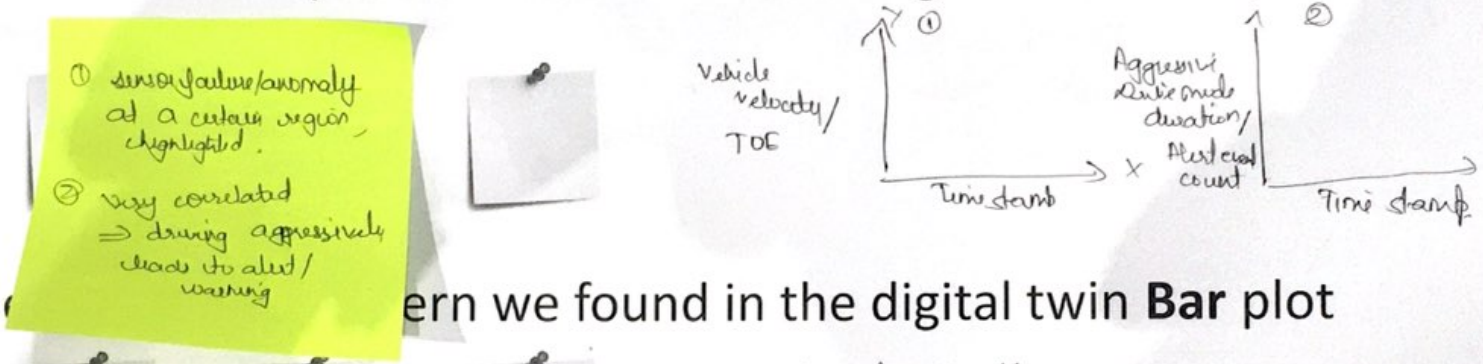
How does the real world influencer and outcome causal fusion table look like ?




4.Industrial AI Blueprint Canvas !
Please fill this up in 30 mins
b.Persona
c.JTD
1.Hindisghts
Show me something interesting ?
Line, Bar, Boxplots, Geospatial
a. Trend Anomalies
Which are areas of interest in signal
trends anomalous behaviors
• Vehicle velocity
• Throttle opening events
[0.9,] => anomaly
One value in the range
1.Insights
Why ? Why ? Why ? Digging deeper into the causal data to make invisible visible
Correlations, Signal Ranking, Frequent sequences, Clustering, Discriminants
a. Correlation
Which causals parameters are
correlated to outcome of interest ?
→ Velocity of vehicle, HV Battery Voltage (-0.636)
→ Vehicle velocity, HV Battery SOC (-0.768)
→ HV Battery voltage, HV Battery current (0.681)
→ all data groups into two clusters with good separation
→ the data points between the clusters are few
a. Signal Ranking
Which are the top 5 causals rank
ordered by influence on outcome?
→ Vehicle Velocity
→ HV Battery Voltage
→ HV Battery Current
→ HV Sudden deceleration / acceleration
→ Rear crash warning alert
Speed of the car can be improved based on HV Battery voltage and Current, giving us good separation and design strategy
8.NBA
What's
based on the insight pattern
ed abov ?

5. Observations – Digital Twin **Visualization**

- Here is the #1 pattern we found in the digital **twin** line plot



- H ern we found in the digital twin **Bar** plot

- Here is the #1 pattern we found in the digital twin **Box** plot

6. Observations – Digital Twin **Anomalous Behavior**

- Which are the top 3 Anomalous behaviors we found in the digital **twin**

In velocity/throttle, results matched with caliber detection

- Why is this Anomalous behavior **significant ?**

→ shows error in sensor

7. Observations – Digital Twin **Correlations**

- Which are the **correlated** to outcome ?

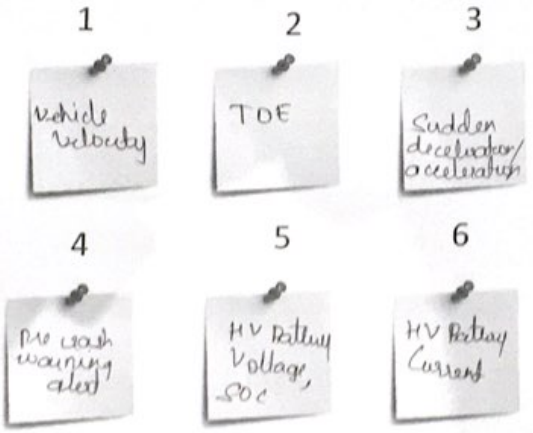
- Which variables are **NOT** correlated to outcome variable ?

- Which variables are **POSITIVELY** correlated to outcome variable ?

- Which variables are **NEGATIVELY** correlated to outcome variable ?

8. Observations – Digital Twin **Signal Ranking**

- Which are the **causals rank ordered by ascending order of influence on** to outcome ?



9. Observations – Digital Twin **Clustering**

- How many Clusters got created?

- What are the key observations regarding the Cluster ?