

HONDA

The Power of Dreams

“Fleet Analytics using MATLAB to build strategies for BS VI Development”

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Content

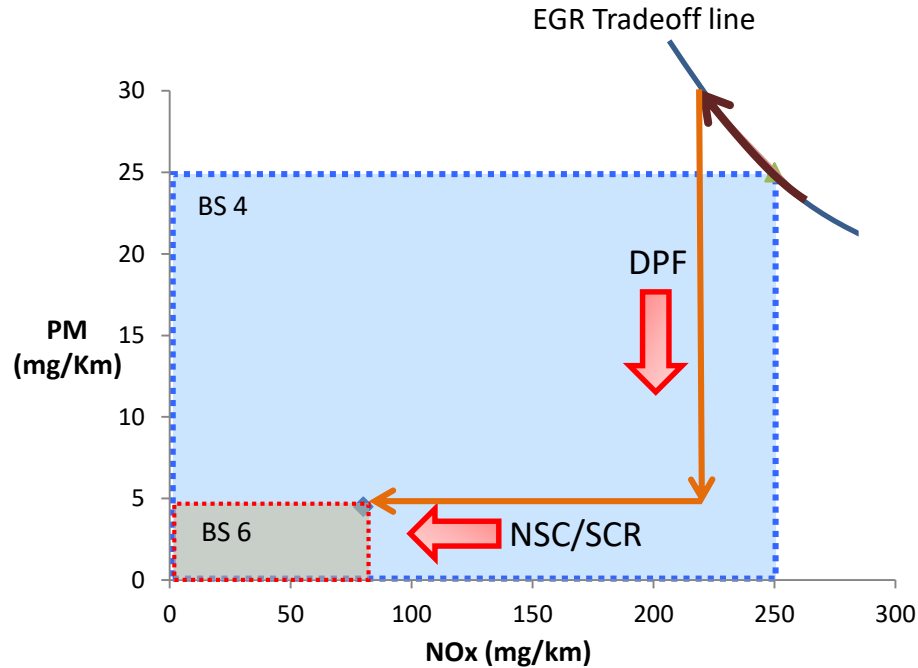
- Abstract
- Introduction to Diesel Particulate Filter (DPF)
- DPF Regeneration Performance concern points
- Indian Market study
- Data Acquisition
- Data Analysis
- Result Interpretation
- Conclusion and Future scope

- ❖ Air pollution in India is at all time high, So life in Indian Cities is getting worse and risk of health hazards like respiratory and skin problems are increasing at an alarming rate, One of the contributors for this scenario are Automobiles.
- ❖ Considering this situation Government has decided to implement stringent emission norms by leapfrogging from BSIV to BSVI skipping BSV Emission norms.
- ❖ Honda being a responsible company is determined to deliver its low emission products as per by government policies .
Therefore we have used latest technology of DPF Systems to deliver cleaner vehicles as per our environmental commitment of *“Blue skies for our children ”*.



BLUE SKIES FOR
OUR CHILDREN

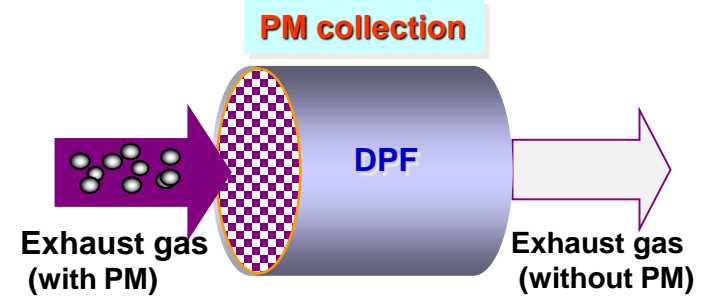
BSVI Emission norms for Diesel Vehicle



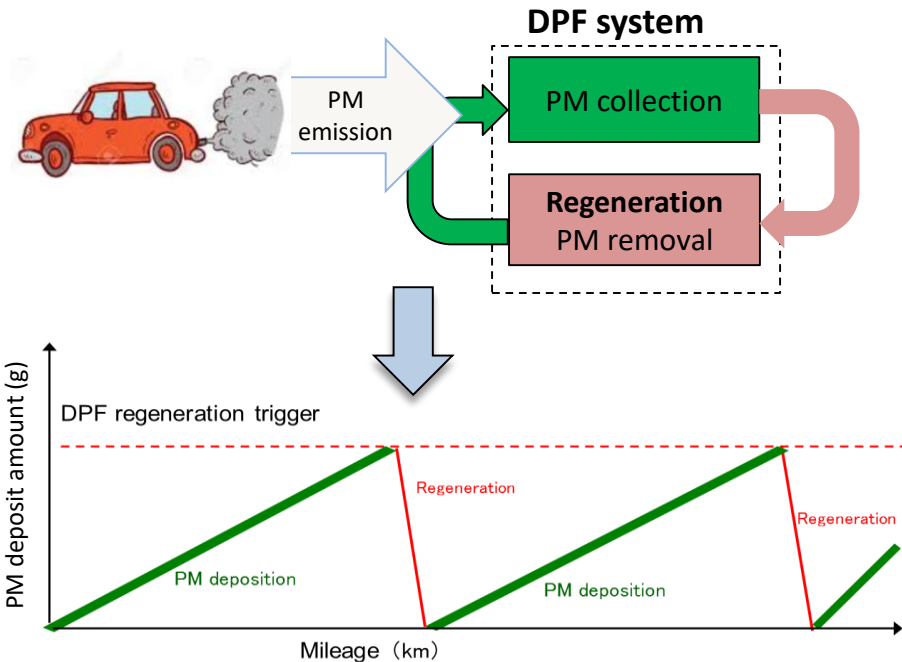
DPF Regeneration Control

- ❖ When estimated PM amount is over the threshold, DPF system will burn PM by increasing exhaust gas temperature.
- ❖ High vehicle speed is the desired condition for regeneration as the Exhaust temperature is high.

DPF Schematic



DPF Regeneration Flow



CONCERN



Traffic condition

Heavy traffic : Exhaust temp cannot rise to desired value to trigger regeneration due to low vehicle speed and frequent start stops.



Indian Market
Study

VALIDATION

Indian Customer Driving
Data Collection



Analyze the Customer
Driving Data

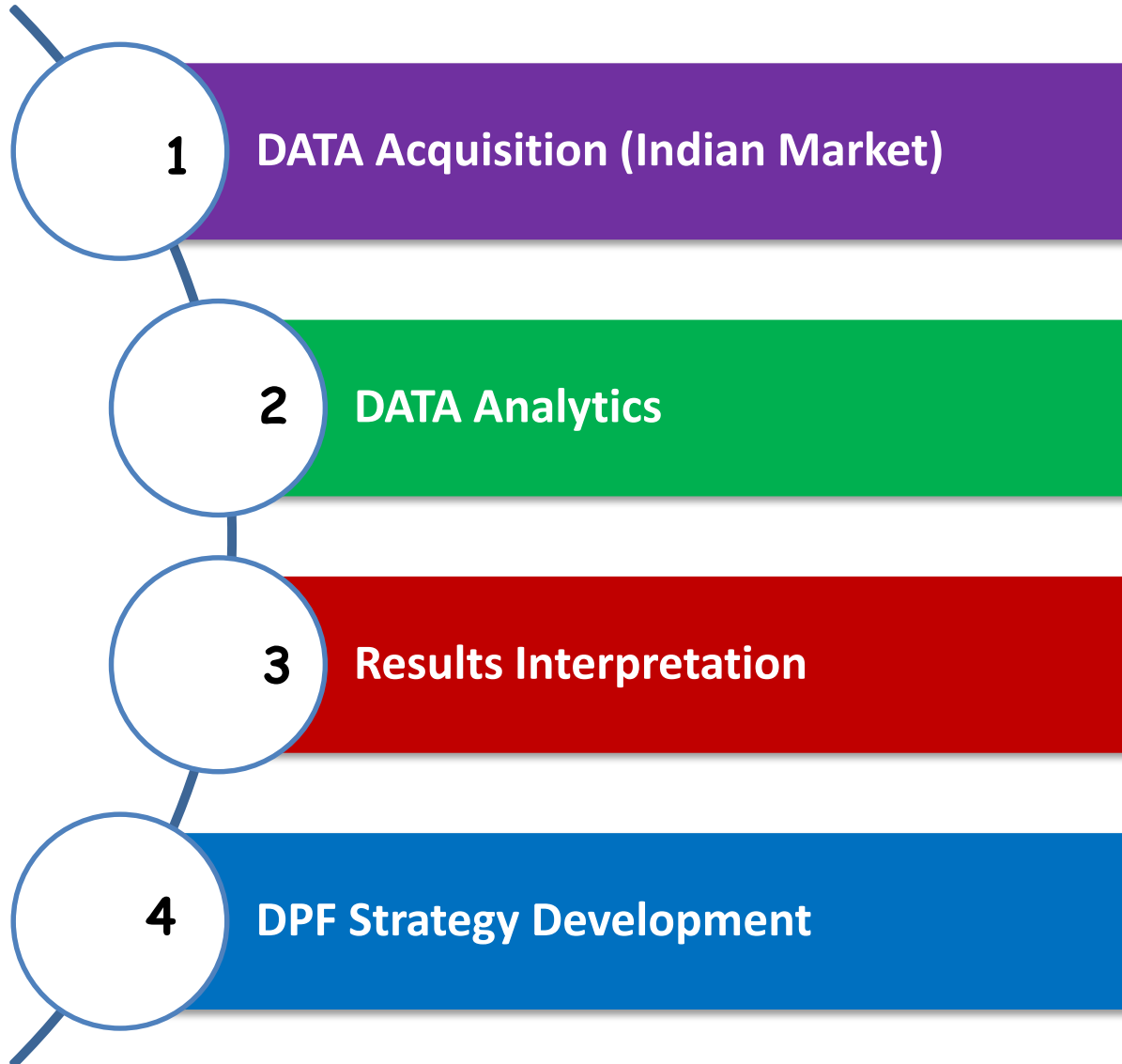


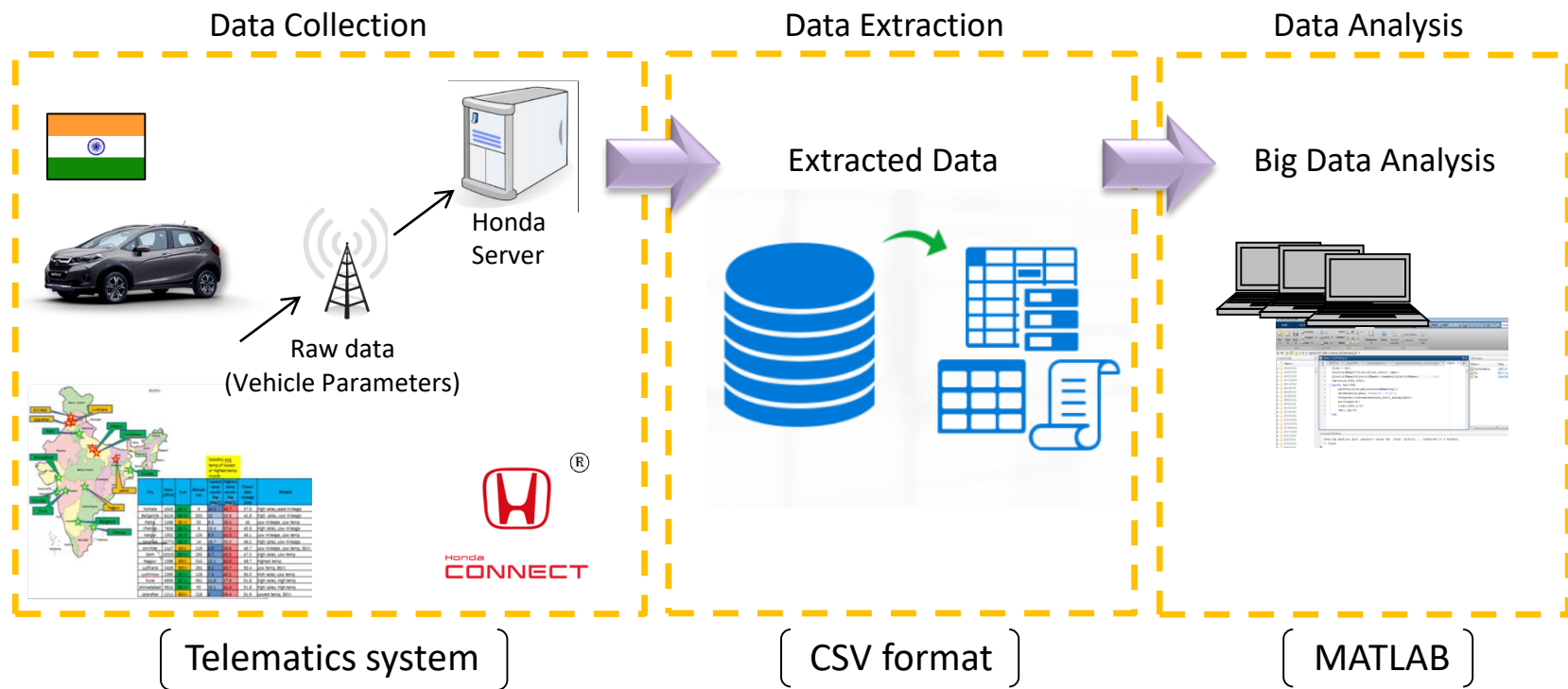
Results Comparison with
Boundary Condition



Finalize the DPF strategies for
Indian Market

Indian Market Study



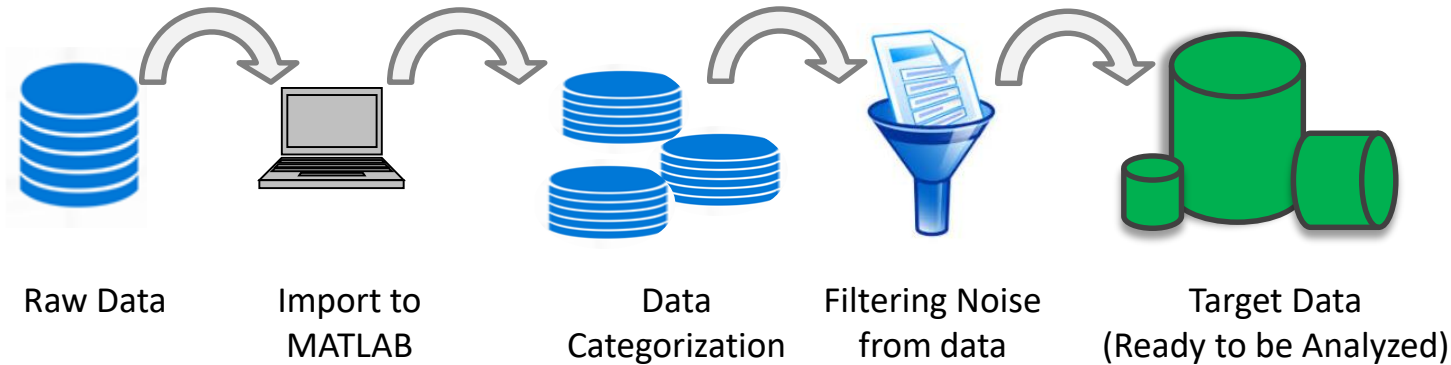


Telematics system was used to collect the data from vehicles, at **per second** sampling rate

Customers : **1000**
Data Size : **20 Gigabytes**
Mileage Covered: **1Million KM**
Driving Cycles : **150 Thousand**

This "**Big data**" is difficult to analyze by conventional tools like excel, So **MATLAB Distributed Computing Server** was helpful for this analysis .

1 Data Pre-processing



```
function All_DC = All_DC1(deviceID_Customer)
All_DC=cell(1,1);
for i=1:985
    T1=deviceID_Customer(i,1);
    % T=cell2table(T);
    a1=categorical(T1.tripstarttime);
    b1=unique(a1);
    h=length(b1);
    T1=table2cell(T1);
    DC1=cell(h,1);
for k=1:h
    l1=(a1==b1(k));
    B=T1(l1,:);
    DC1(k,1)=B;
end
All_DC(i,1)=DC1;
DC1=[];
end
end
%clearvars -except idle deviceID_Customer All_DC;
```

Program to segregate customers from raw data

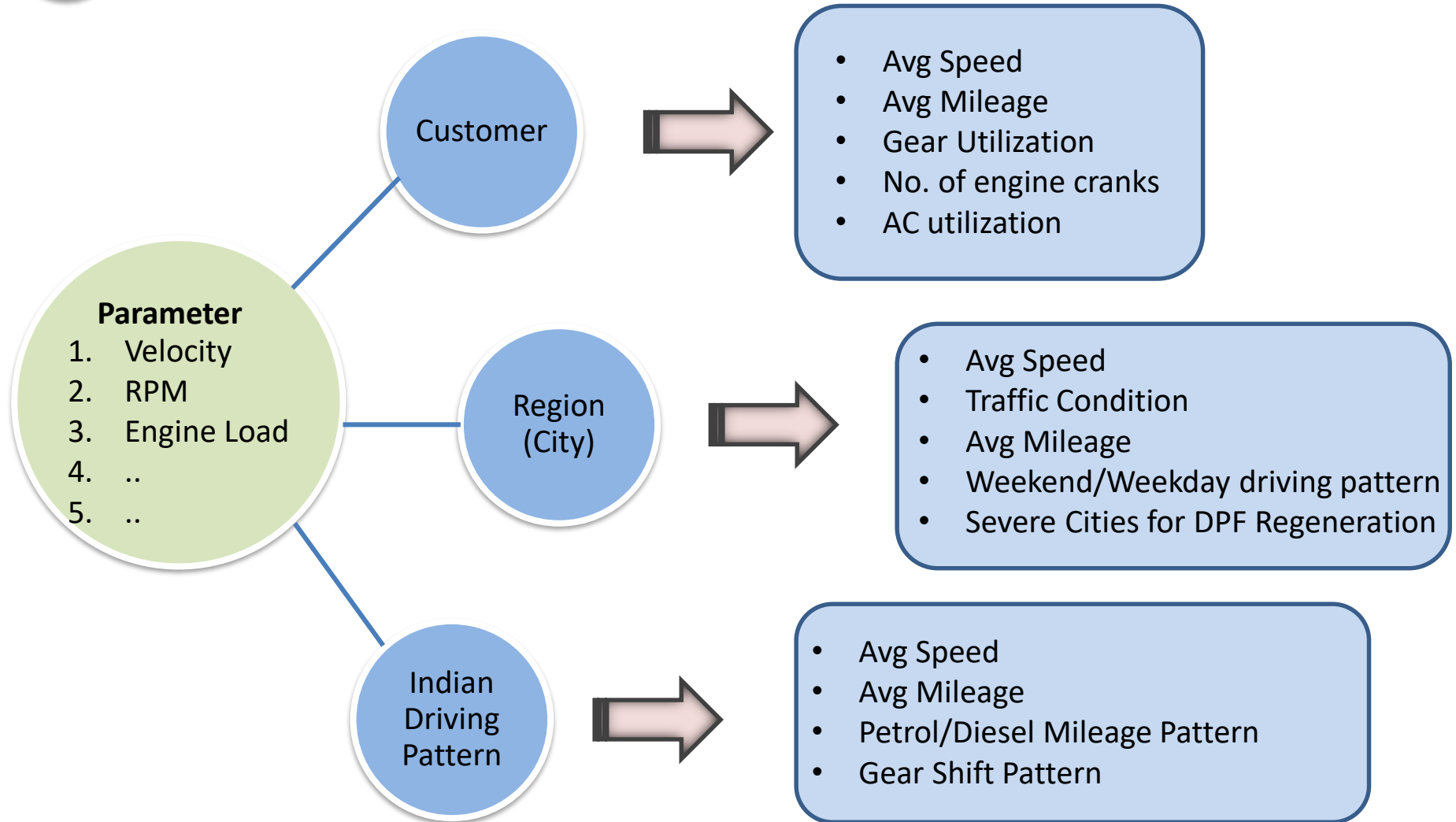
- Initially the Raw Data was not categorized in the desired format.
- Using MATLAB this raw data was Categorized and filtered in the Desired format.

← Codes →

```
function [deviceID_Customer,T,a,b1]=trial4_10sec_30(pwd,a1)
ds=dataset(pwd,'ReadSize','file','delimiter',' ');
ds.SelectedVariableNames ={'deviceID','timestamp','tripstarttime'};
ds.SelectedFormats={'%q','%q','%q','%q','%f','%f','%f','%f'};
T=readall(ds);
clear ds;
% stamp1=datetime(T.timestamp,'InputFormat','eeee MMMM dd yyyy HH
% K=height(T)-2;
% stamp2=stamp1(end-K:end,:);
% stamp1(end)=[];
% difference=stamp1-stamp2;
% difference(end)=duration(00,00,01);
% T.timestamp=difference;
% clear stamp1 stamp2 difference;
a=categorical(T.deviceID);
%a1=categorical(VIDD.V_ID);
b=unique(a);
%b=unique(d);
h=length(b);
deviceID_Customer=cell(h,1);
%T=table2cell(T);
% v=1;
for i=1:h
    l1=(a==b(i));
    deviceID_Customer(i,1)=T(l1,:);
```

Program to segregate Driving cycle of each customer

2 Feature Extraction



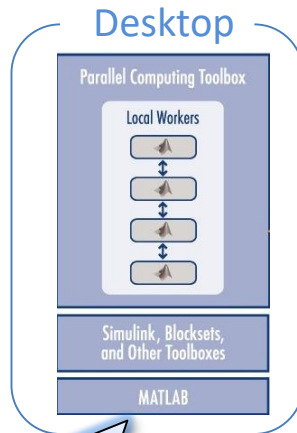
Domain level expertise and MATLAB programming was used to extract all mentioned and not mentioned features from the limited target parameters

3 Challenges

- i. **Data processing time was very long** due to the huge amount of data, Hence Code optimization and parallel-processing tools were required.



Solution



Parallel Computing
This toolbox allows the desktops to use their multicore processing capability by executing applications on workers that run locally .

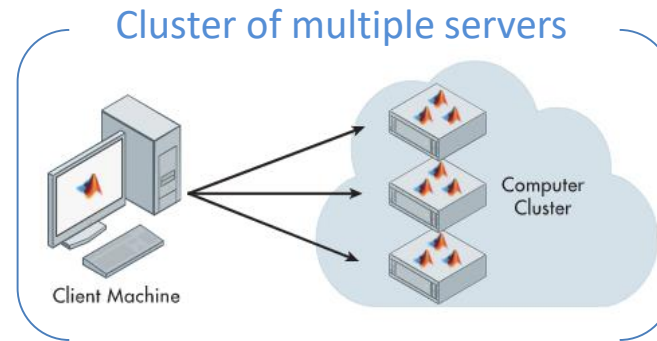


Image Source : MathWorks

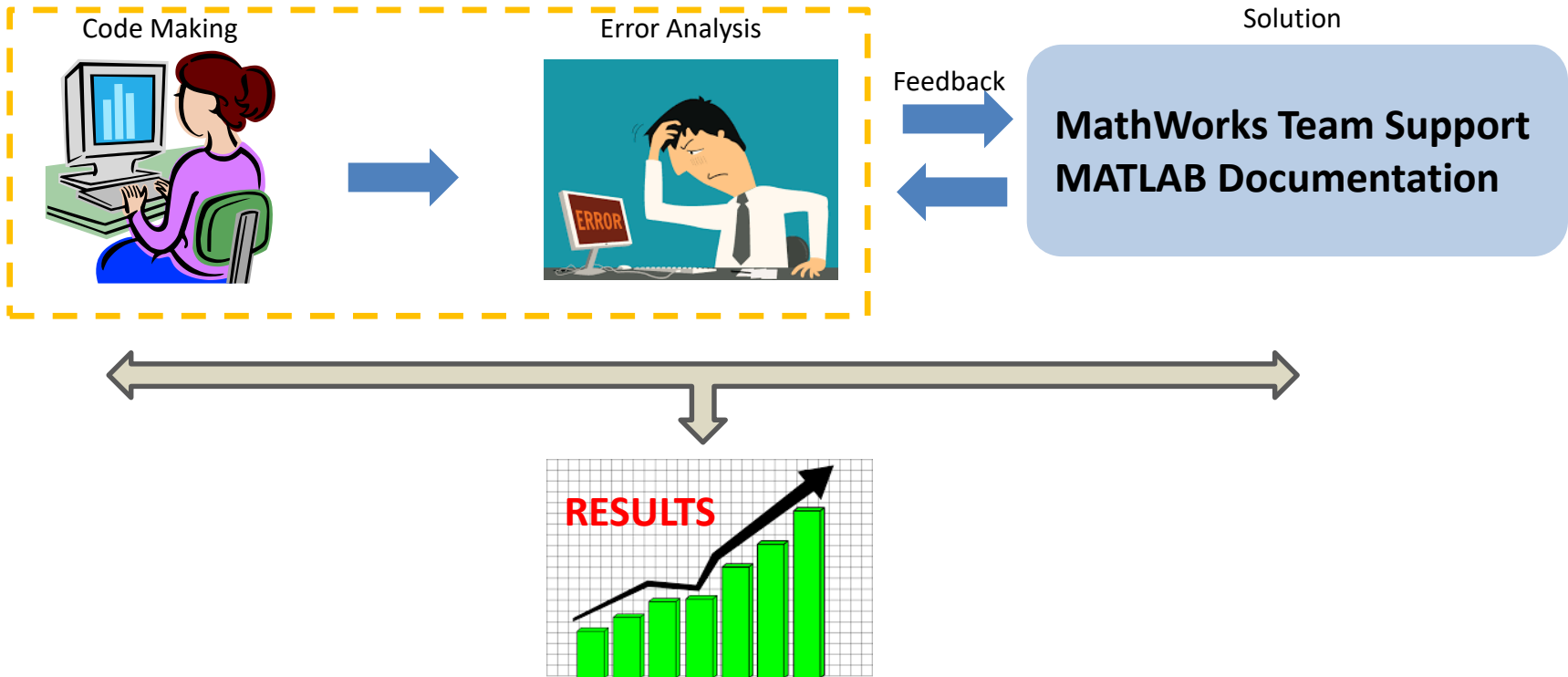
MATLAB Distributed Computing Server (MDCS)
Allows to run programs on computer clusters, and then scale up to many computers by running it on MDCS.

3

Challenges

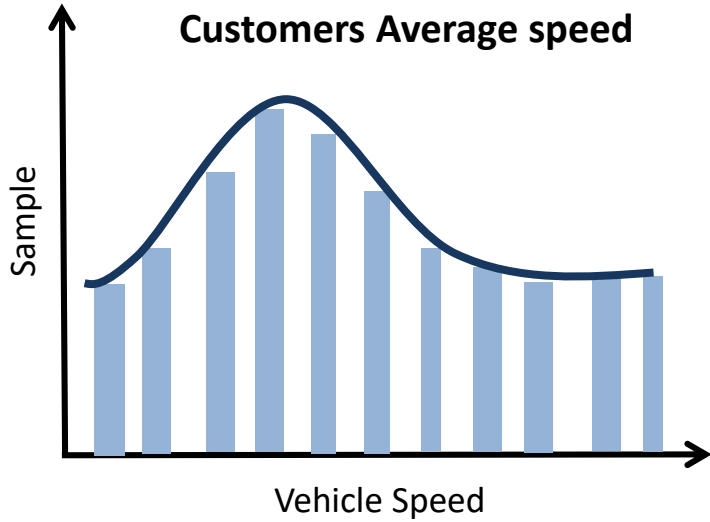
ii. **MATLAB Coding** : As per our Development goals, Advance MATLAB Coding Skills were required to be attained in limited time to meet project timelines.

Solution



Through trainings and multiple trials, required coding skills were developed with the support of MATLAB team which was useful for our Project Completion and future developments .

Customers Average speed

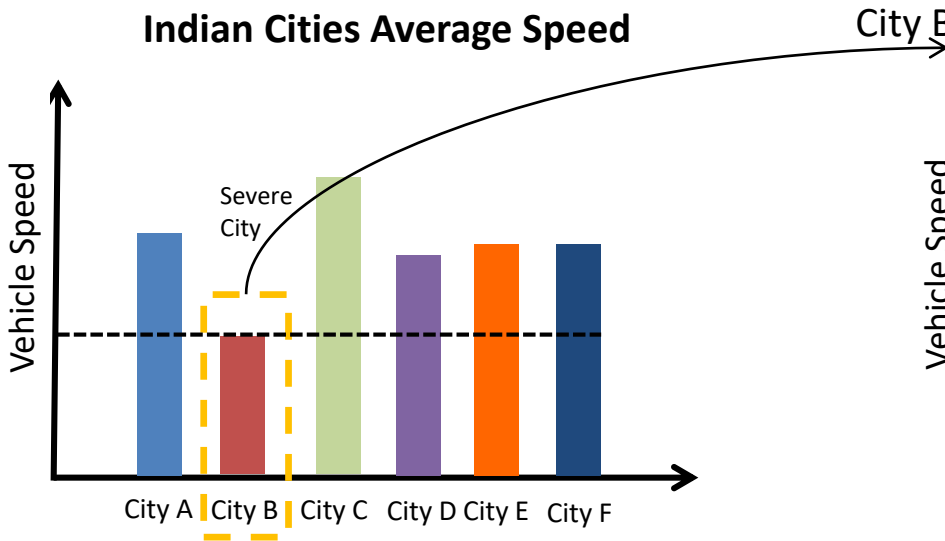


Customer Results were analyzed on the basis of different parameters like average speed, average mileage, etc for

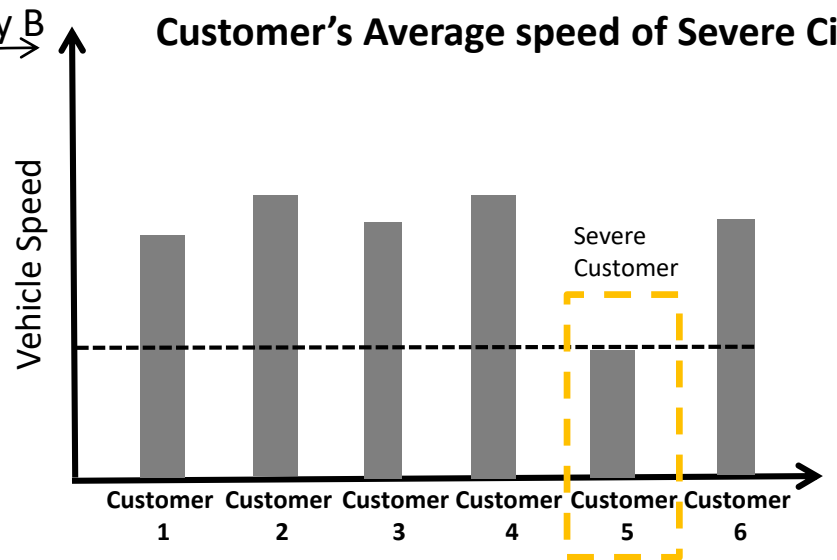
- a. Individual Customer**
- b. Region (City)**

For deciding Final DPF Strategy and Calibrations for Indian Market.

Indian Cities Average Speed



Customer's Average speed of Severe City



These results were necessary in determining Honda's strategy for BSVI Development

CONCLUSION

- ❑ Indian Customer's Driving Pattern and Indian Traffic Conditions were analyzed using MATLAB which were used to decide Honda's BSVI strategy.
- ❑ MATLAB tools were found very effective for this type of analysis and the support from MathWorks engineers is appreciated.
- ❑ Through this project Honda have developed know how and infrastructure to handle big data, so in future this type of analysis will be used for further development of research models.

FUTURE SCOPE

- ❑ Honda will continue Big data Collection and Analysis for development of Hybrid & Electric Vehicles
- ❑ MATLAB GUI for fleet analytics will be prepared to reduce testing and development time

THANK YOU



QUESTIONS AND DISCUSSIONS

