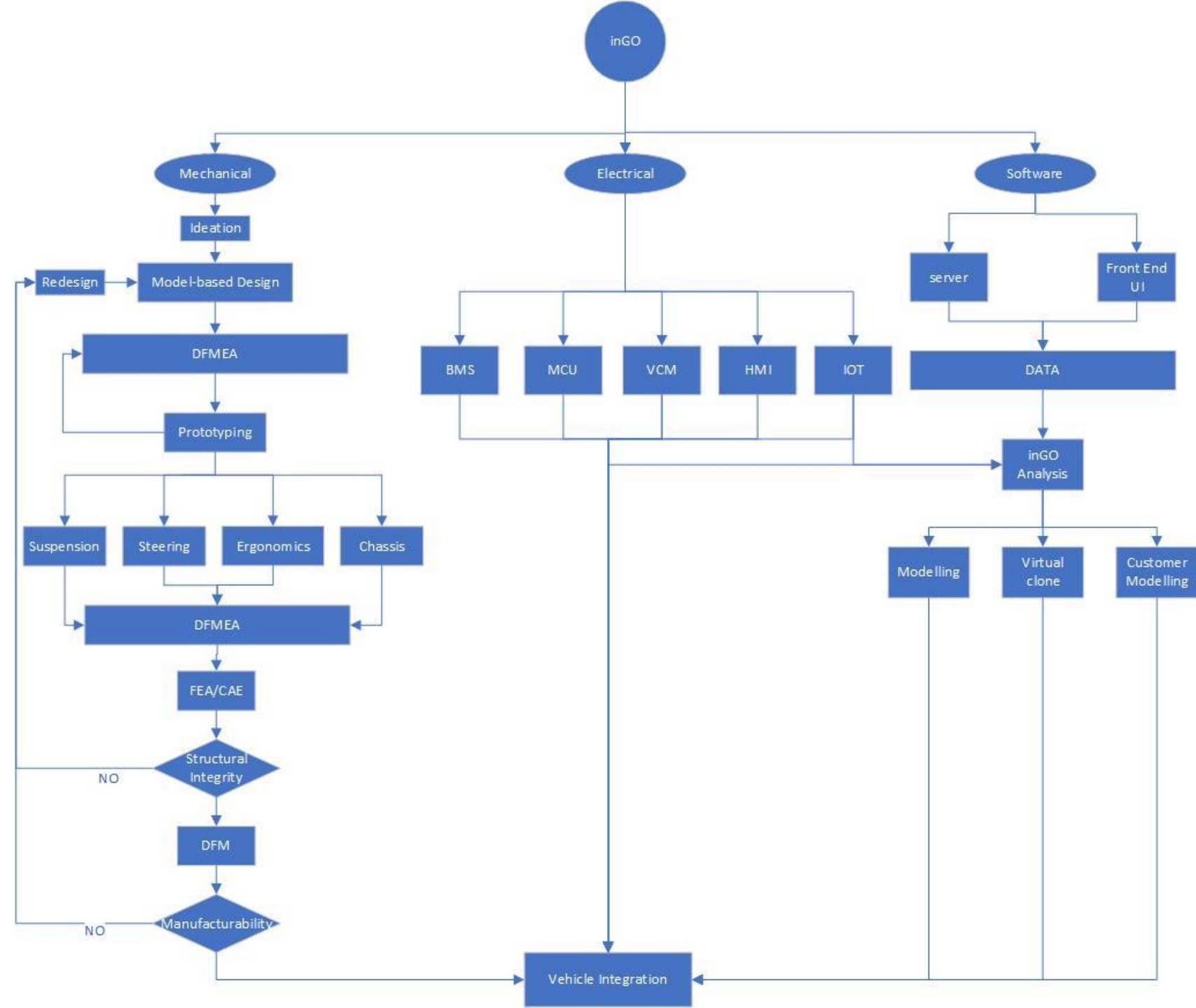


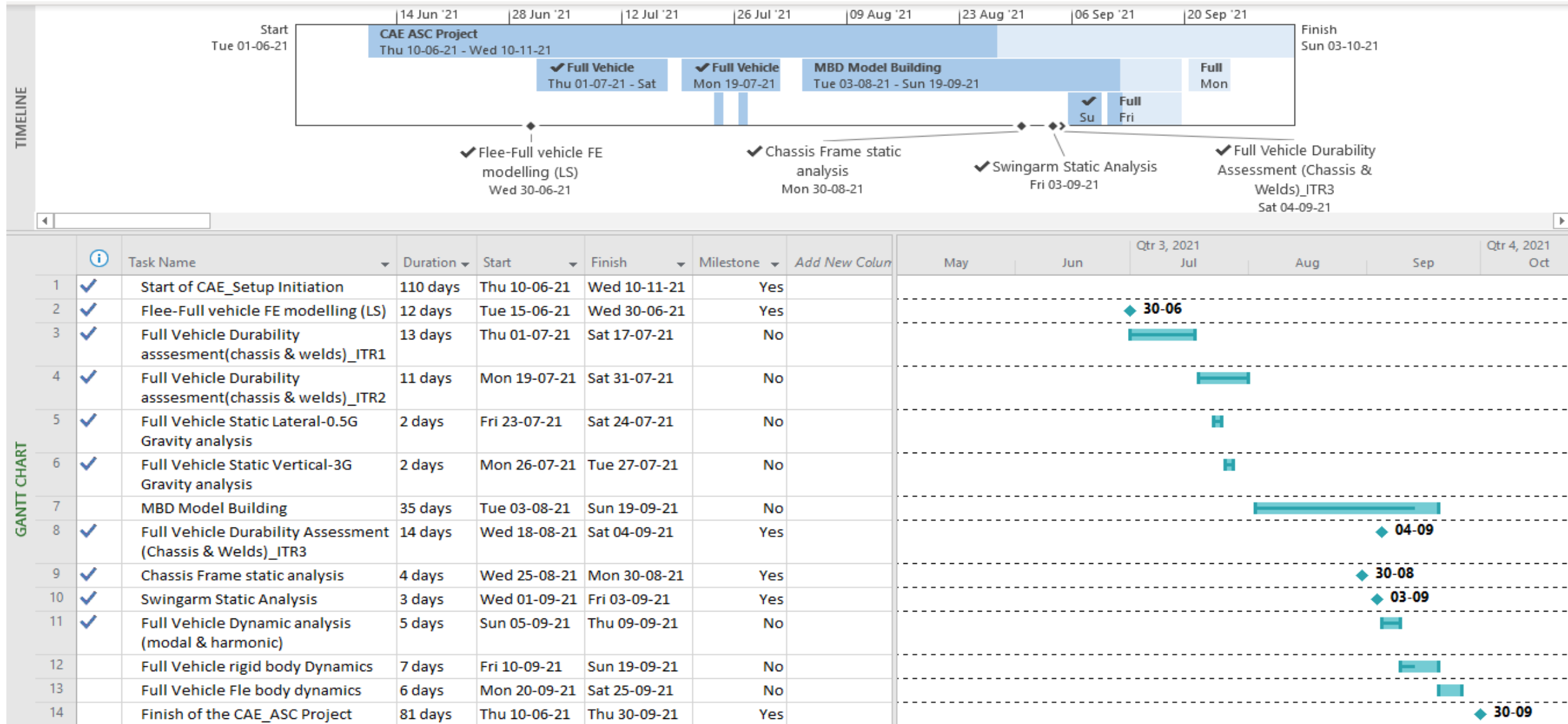
Design and CAE analysis of 2W EV chassis and components

Product Lifecycle

- The product is currently in the mass production stage with first set of 60 vehicle under manufacturing.
- Design optimization in terms of improving structural ability and DFM is being carried on from the design front.



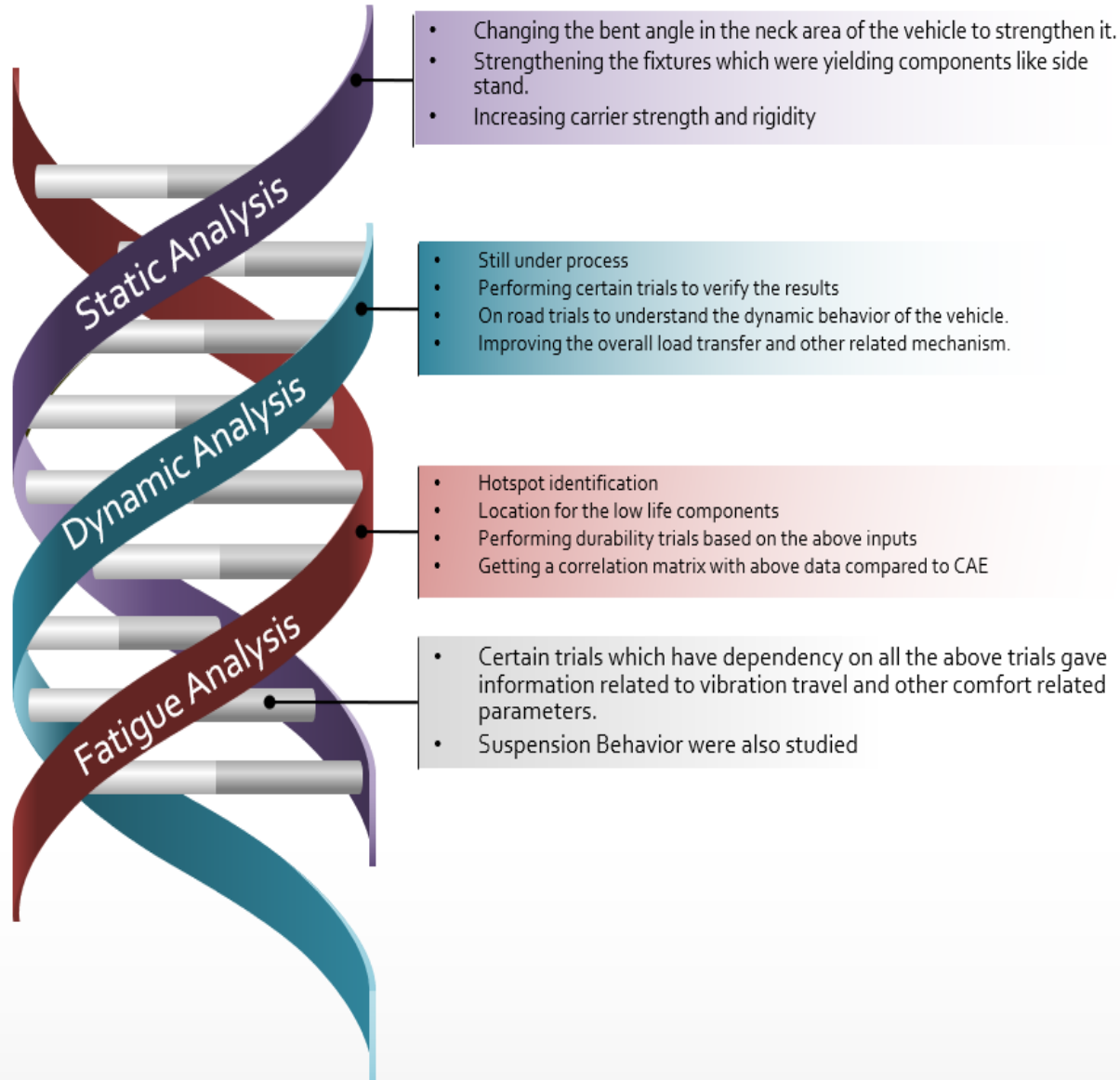
Timeline Phase 1



Problem statement progress

Topic	Output	Percentage
Full Vehicle Durability Assessment 1. Chassis Fatigue 2. Weld Fatigue	1. Virtual Life of the chassis 2. Weld Hot spots for SG analysis	100
Chassis Static Strength Analysis	1. Chassis Strength under different loading conditions	100
Full Vehicle Static Analysis 1. Lateral (0.5g) 2. Vertical (3g)	1. Stress location hotspots 2. Material failure (if any)	100
Components Static Analysis 1. Critical component mounting	Component strength and deflection	100
Full Vehicle Dynamic Simulations 1. Excitation at axle 2. Excitation at vehicle Under gound Bracket	1. Vibration of components 2. Stress	100
MBD analysis 1. Rigid Body analysis 2. Flex Body analysis	1. Force transmission through chassis 2. Vibration Transmission 3. Stress	15
Suspension Behavior	Transmission of vibrations to critical components like handle, seat etc.	100
Vehicle Dynamic Study	Drivers stability and comfort during the ride	0

Project Team & Methodologies Development



Shreyas. R R&D/CAE

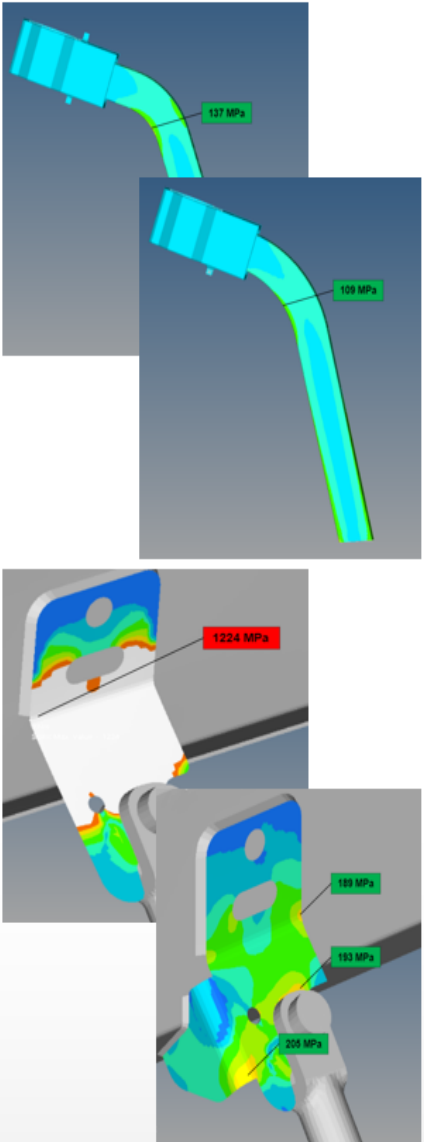
M.Sc. Motorsport Engineering

- 1-D simulation, Design processes and validation, Component concept development, CAE

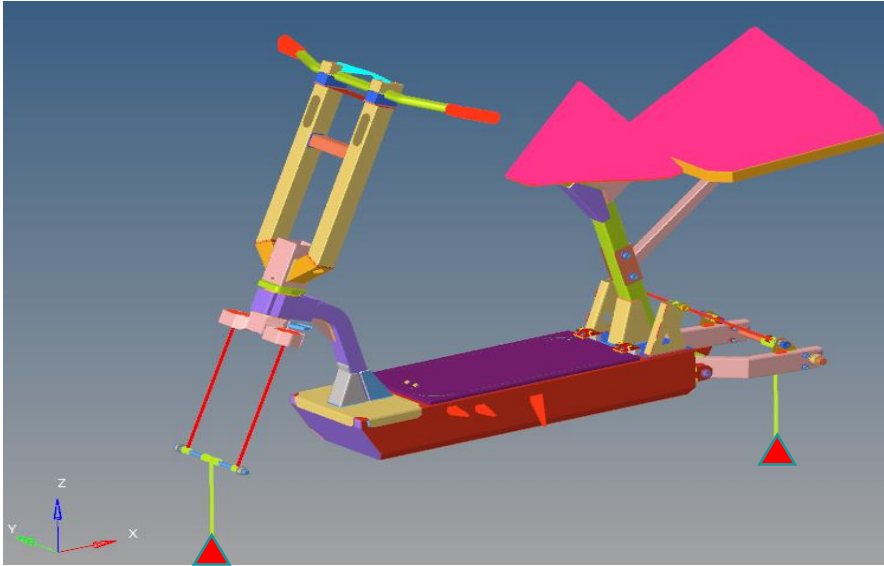
Swapnil Chandrakar testing & Validation

M. Tech Automotive Engineering

- Data analysis, RLDA testing, test & validation methodologies



Full Vehicle Static Analysis



- Lateral (0.5g) Static Analysis
- Vertical (3g) Static Analysis
- Boundary Conditions: Base is fully constrained

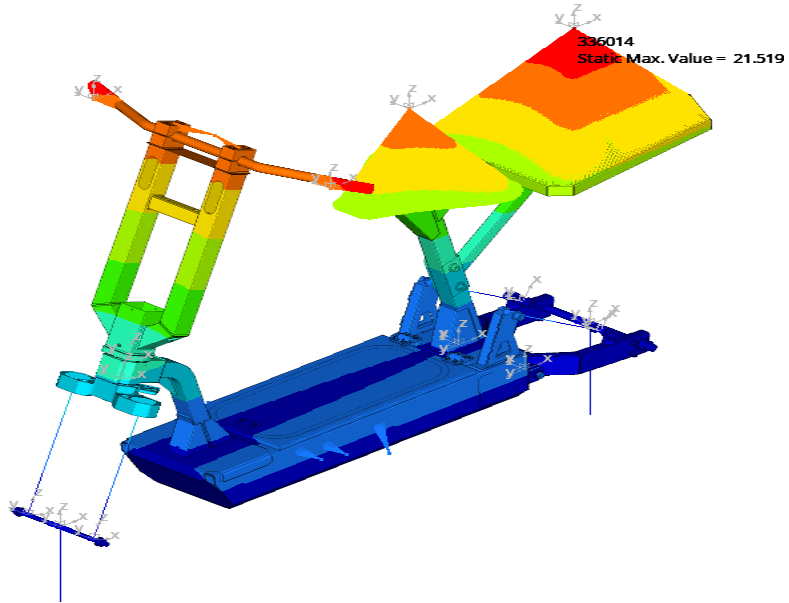
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Color:		Color:	
Include:	[Master Model]	Include:	[Master Model]
Card Image:	GRAV	Card Image:	GRAV
User Comments:	Do Not Export	User Comments:	Do Not Export
CID:	<Unspecified>	CID:	<Unspecified>
G:	9810.0	G:	9810.0
N1:	0.0	N1:	0.0
N2:	0.5	N2:	-0.5
N3:	0.0	N3:	0.0

Displacement results shown in below animation

Contour Plot
Displacement(Mag)
Analysis system

2.152E+01
1.913E+01
1.674E+01
1.435E+01
1.196E+01
9.564E+00
7.173E+00
4.782E+00
2.391E+00
0.000E+00
No Result

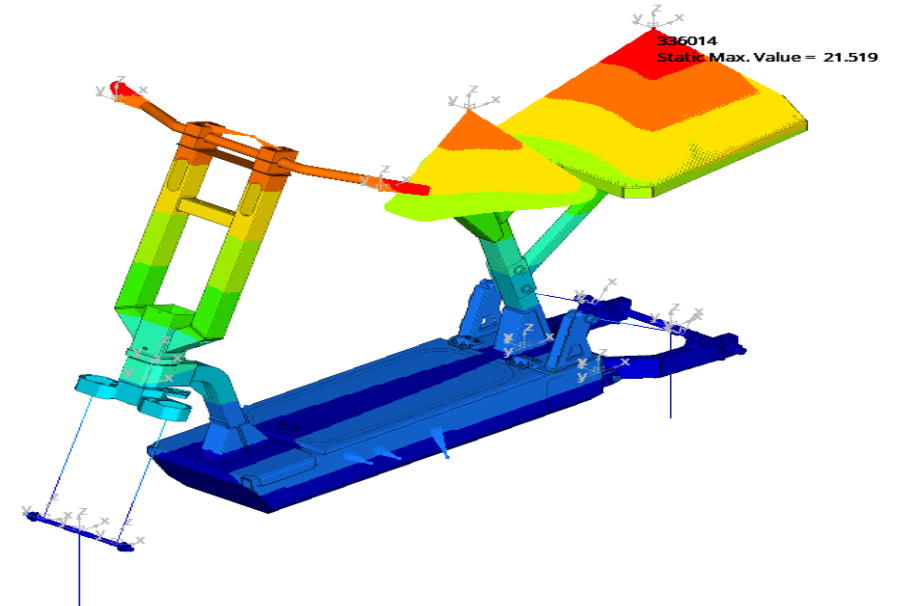
Max = 2.152E+01
Grids 336014
Min = 0.000E+00
Grids 252627



Contour Plot
Displacement(Mag)
Analysis system

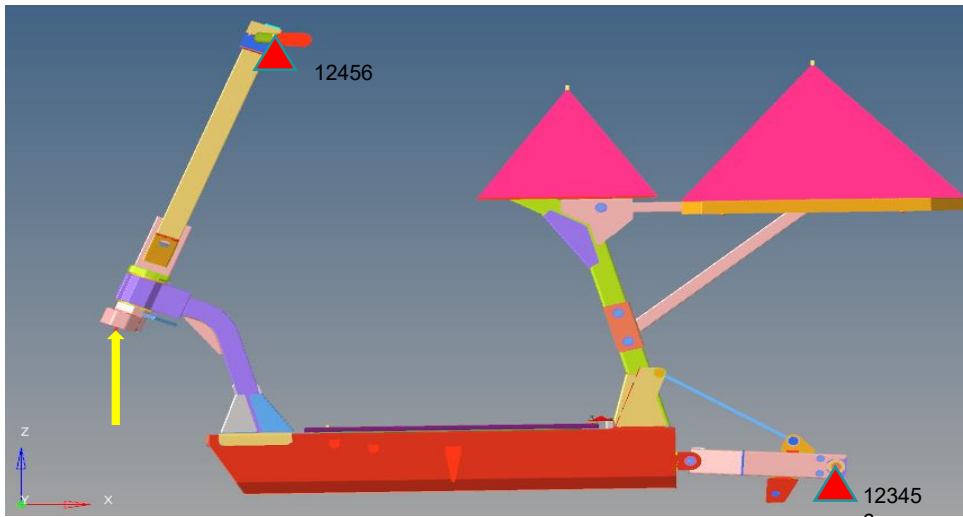
2.152E+01
1.913E+01
1.674E+01
1.435E+01
1.196E+01
9.564E+00
7.173E+00
4.782E+00
2.391E+00
0.000E+00
No Result

Max = 2.152E+01
Grids 336014
Min = 0.000E+00
Grids 252627

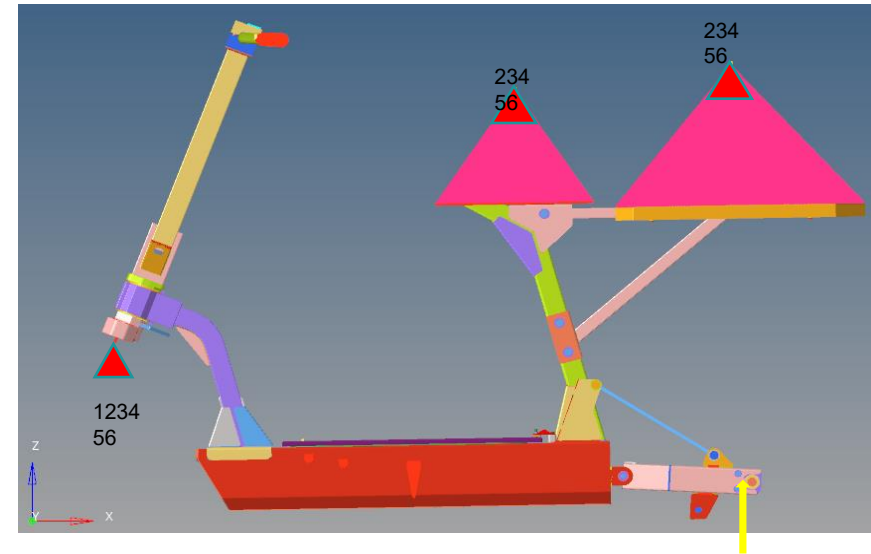


Fatigue Analysis: Setup and loading conditions

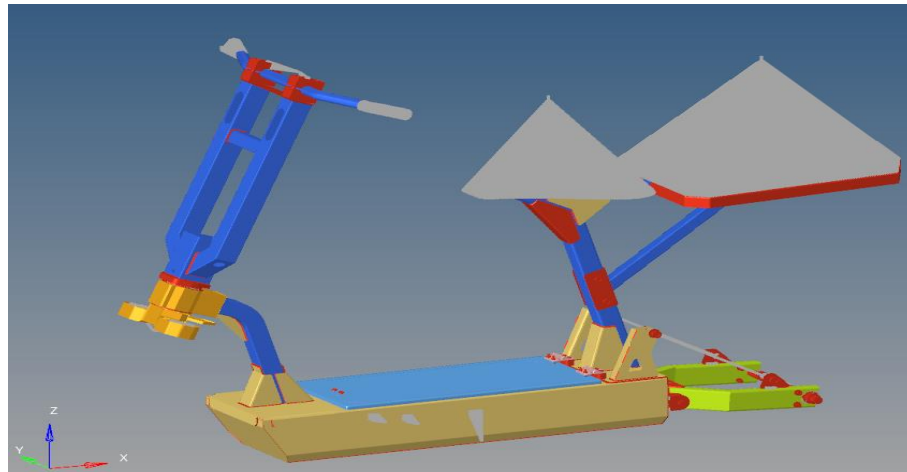
Unit Cases



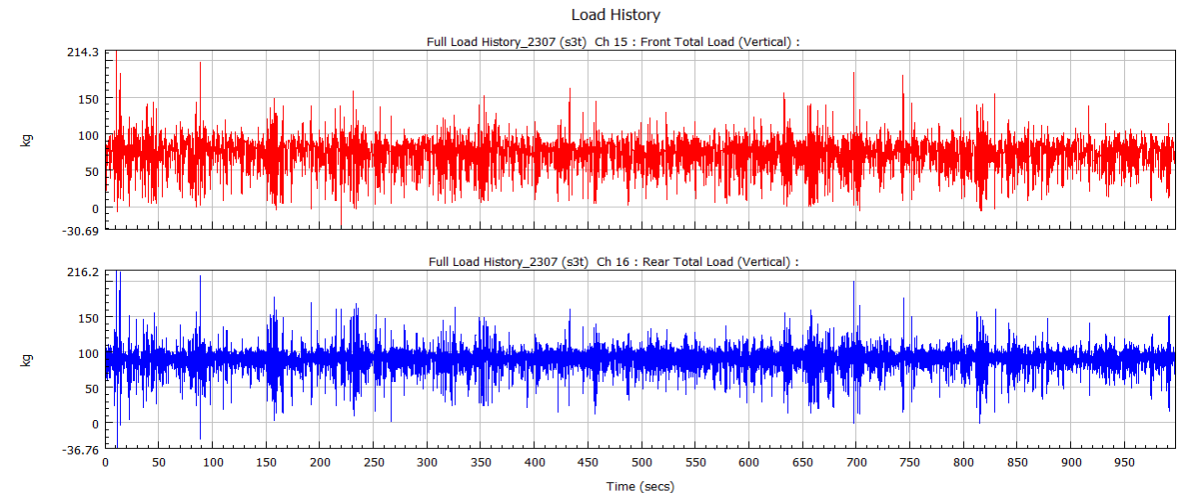
Front Unit Case: Static load of 1N in +Z direction was applied at the front shock holder.



Rear Unit Case: Static load of 1N in +Z direction was applied at the rear wheel center.



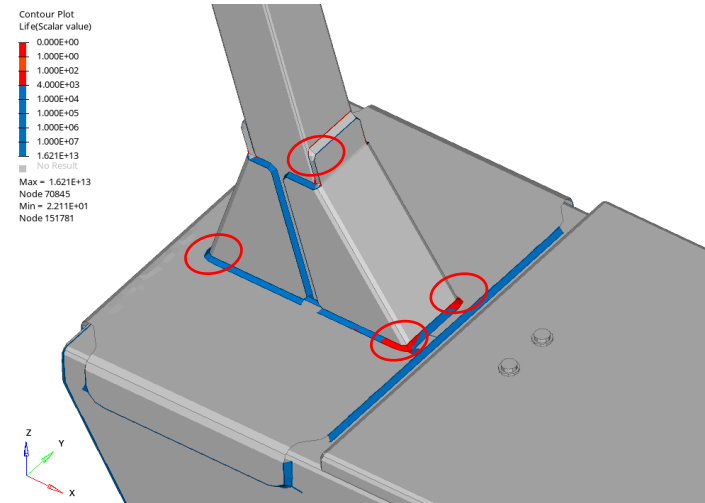
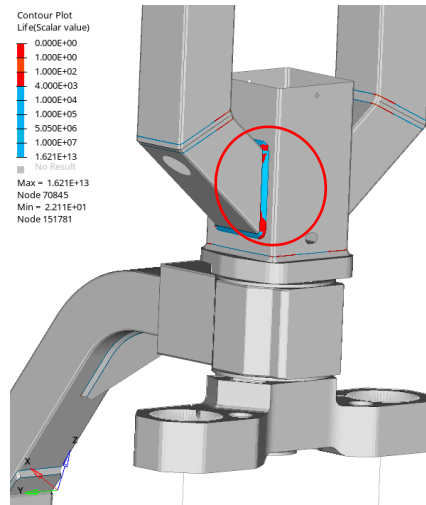
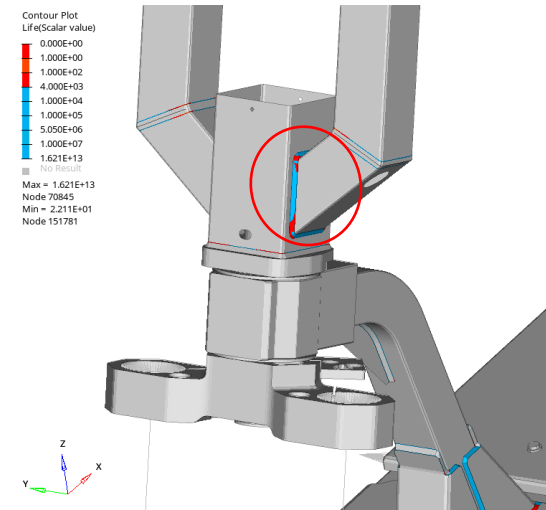
a) Model



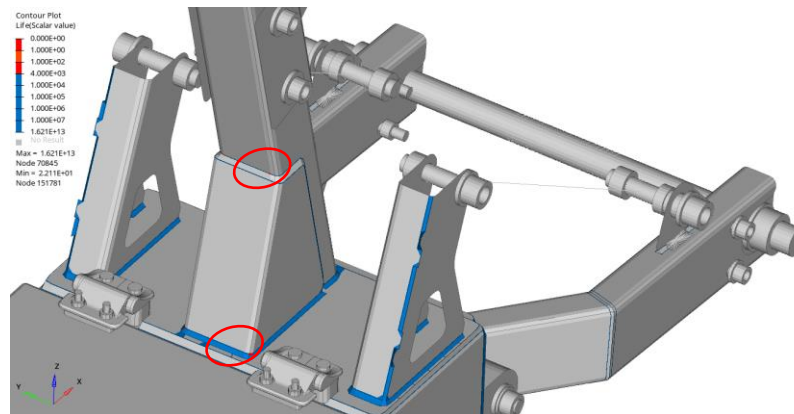
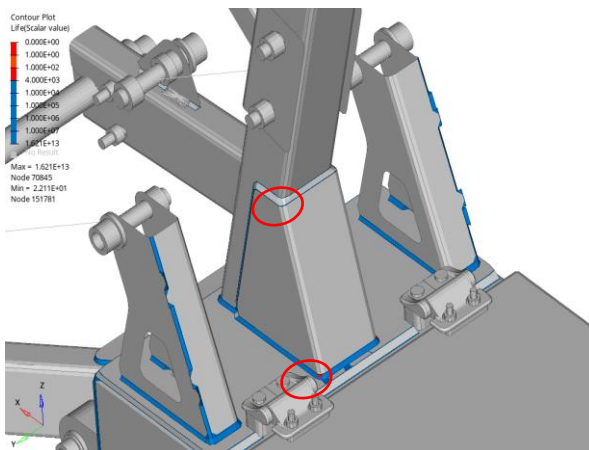
b) Simulated Load data

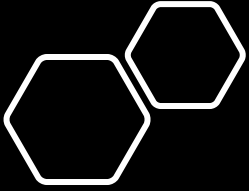
Fatigue Analysis: Summary

Regions less than < 4000 cycles



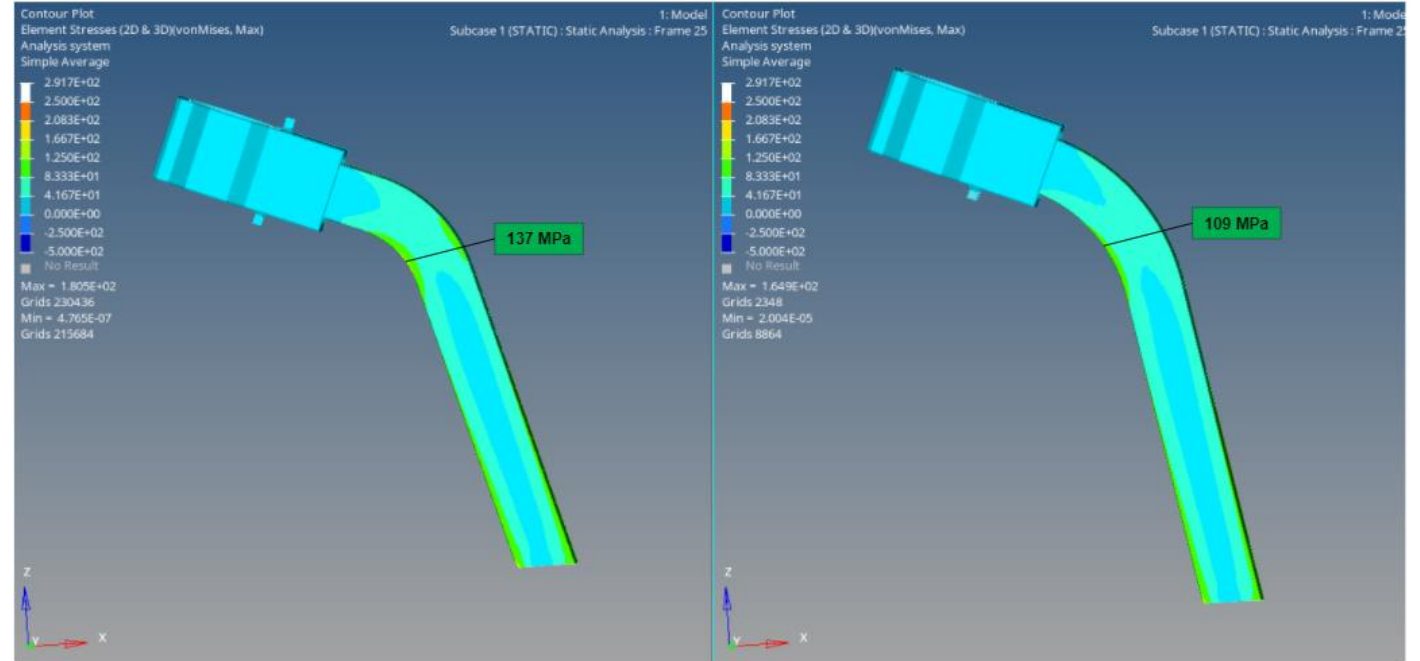
- Target Life - 50,000kms
- Target Cycles – 4,000
- Most of the chassis' components surpass this hurdle, except for few weld locations mentioned here.
- These locations will be the subject for study during strain gauge analysis.





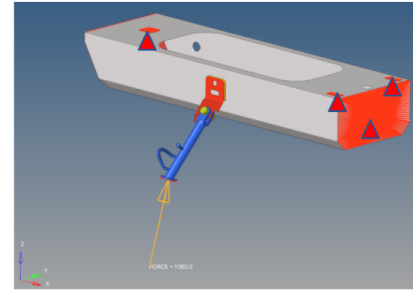
Design Improvements based on critical areas identified by various analyses

- Bend radius of the headset holder updated, to reduce the stress in static.
- 2100N load was applied along suspension line of action.



Design Improvements based on critical areas identified by various analyses

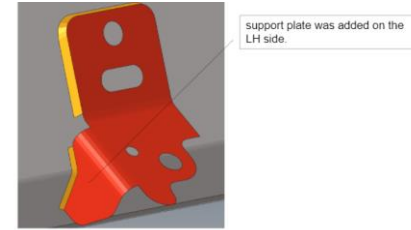
- Side Stand bracket was evaluated under fatigue loading.
- 1000N load was applied in the stand lean angle line of action.
- C2 Design with a max load of 100kg experienced absolute failure.
- Support plate was added on the LH side based on the Hyperworks simulation for C2.5.
- C2.5 design had a min life of 368,000 cycles under 100 kg max load and about 10,000 cycles under 150kg max load.
- This is falling under the acceptance criteria under the 100 kg max load.



Static unit case:
1000 N force was applied.
Y - component – 292.37 N
Z - component – 956.30 N



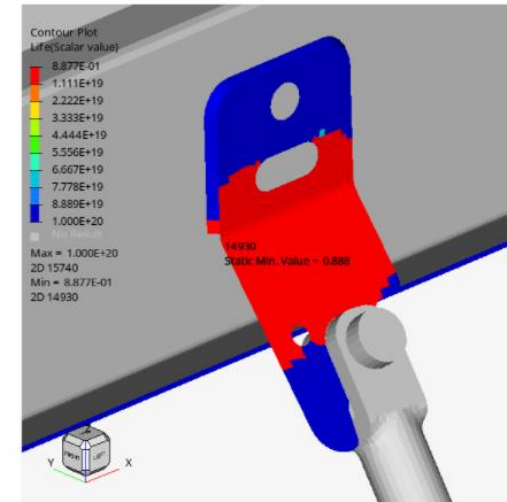
C2 model (4mm)



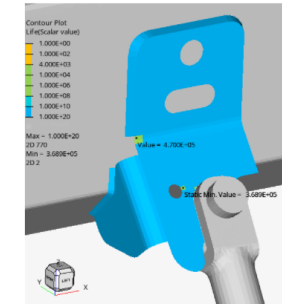
C2.5 design (6mm)

Boundary Conditions: All DOFs fixed

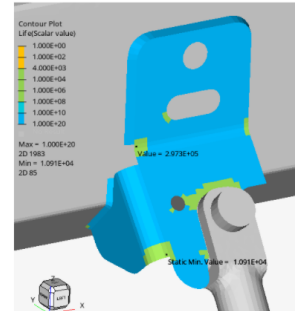
C2 design with max load 100kg (Absolute Failure)



CASE-1
C2.5 design with max load 100kg



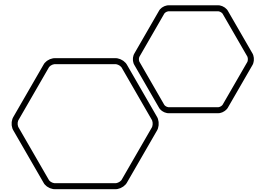
CASE-2
C2.5 design with max load 150kg

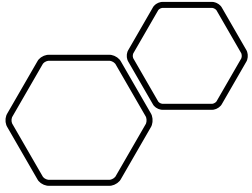




Analysis Results and RLDA initiation

- Accelerometers are placed at strategic locations in and around the vehicle.
- RLDA testing is currently under way.
- The results from this are going to be used in Altair's Hyperworks and the analyses would be run again, after which a co-relation could be obtained.





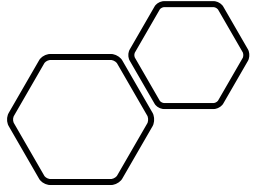
Manufacturing

- The vehicle is launched in the market for early adopters
- We have setup manufacturing and production unit in Peenya Industrial Estate to collaborate better with our vendors
- We have collaborated with Essae for assembly which enables us to focus solely on scaling and expanding production capabilities





		+					
		5					
Likelihood of Failure	4						
	3			R2			R1
	2	R3					
	1						
		1	2	3	4	5	
		Consequence of Failure					



Sourcing: Components and materials

- Steel and Aluminum Sourced from Tata and jsw with future capacity of 10,000units of custom sizes.
- Partnered with Big automotive parts manufacturer already for majority of components, which includes both in-house design and off-shelf components
- All these manufacturers capable of ramping up supply to >10000 p.p.m
- Partnering with PAN India logistics player with cloud platform operated supply chain management system

