HORIBA MIRA

Virtual Durability Development

Enabling the development of SMART prototypes by using HORIBA MIRA's virtual durability processes

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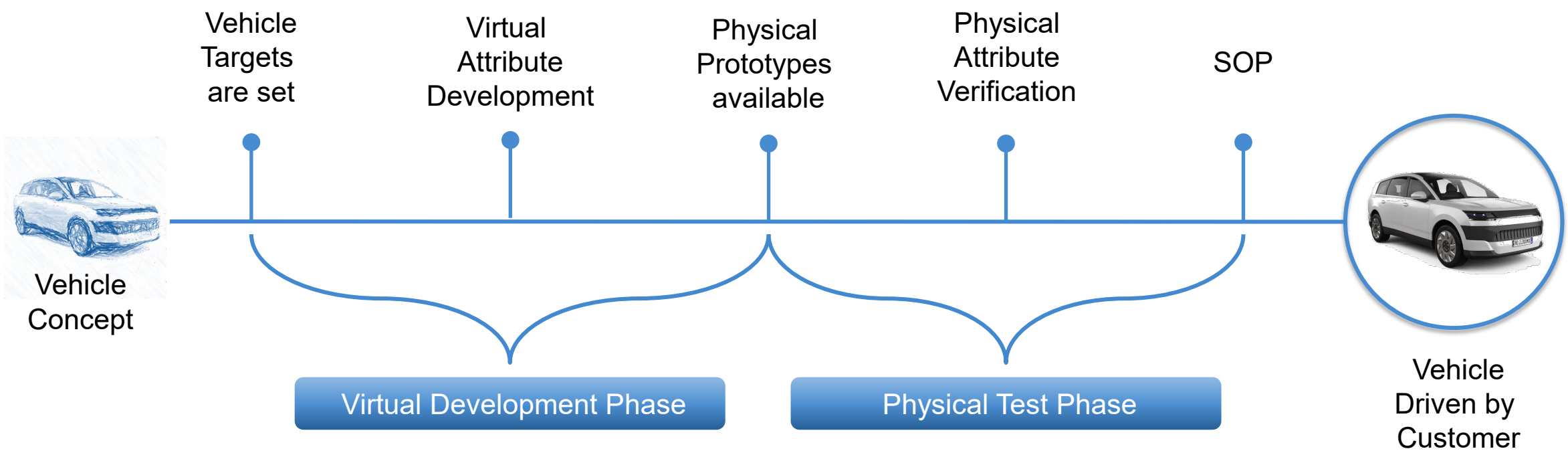
Consultant for Integrated Durability Engineering

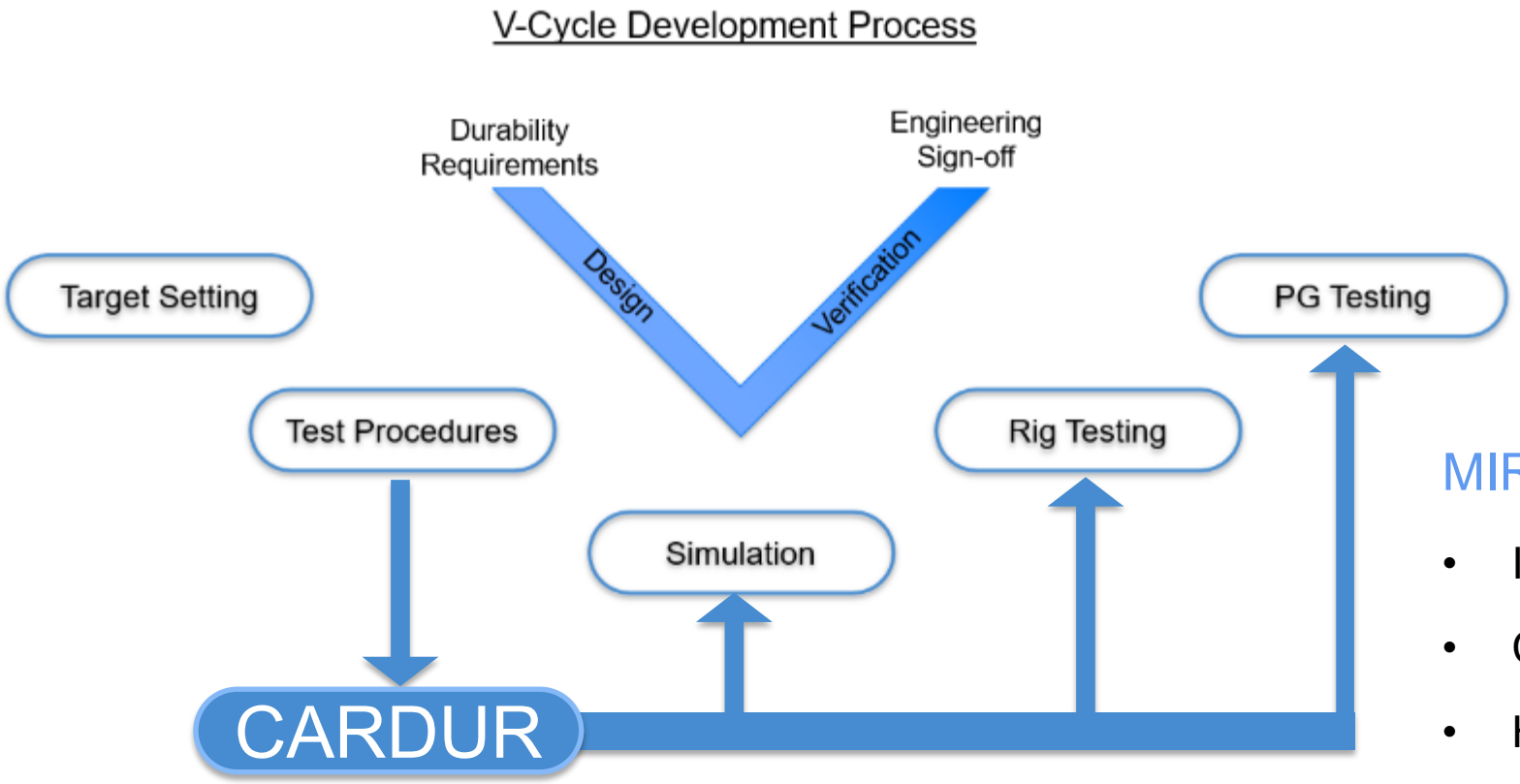
We provide vehicle manufacturers with world-class vehicle engineering, test, and development consultancy; plus an inspiring location for shaping tomorrow’s technologies, today.

Who we are.

The challenge is time



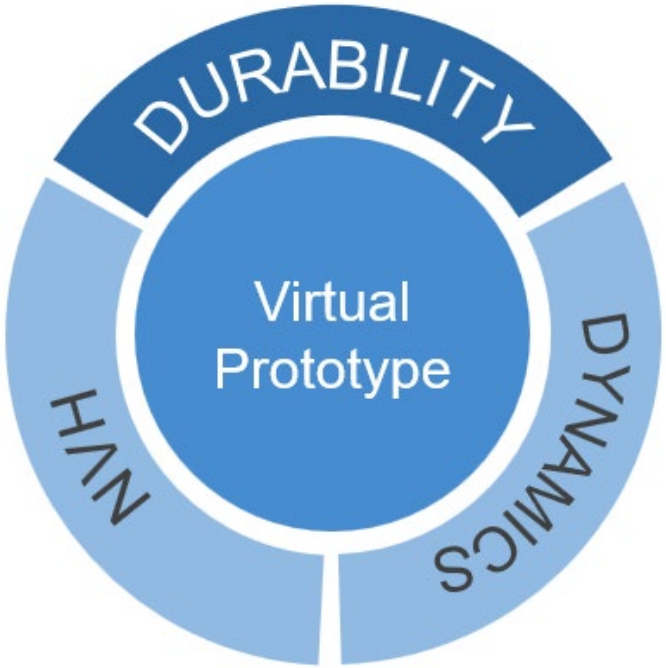
Integrated Durability Engineering



MIRA's CARDUR

- Industry recognized test cycle
- Correlated to real world usage
- Highly accelerated for fast failure detection
- Aligned to Virtual Durability Toolset
- Linked target across all verification steps

Virtual prototype purpose

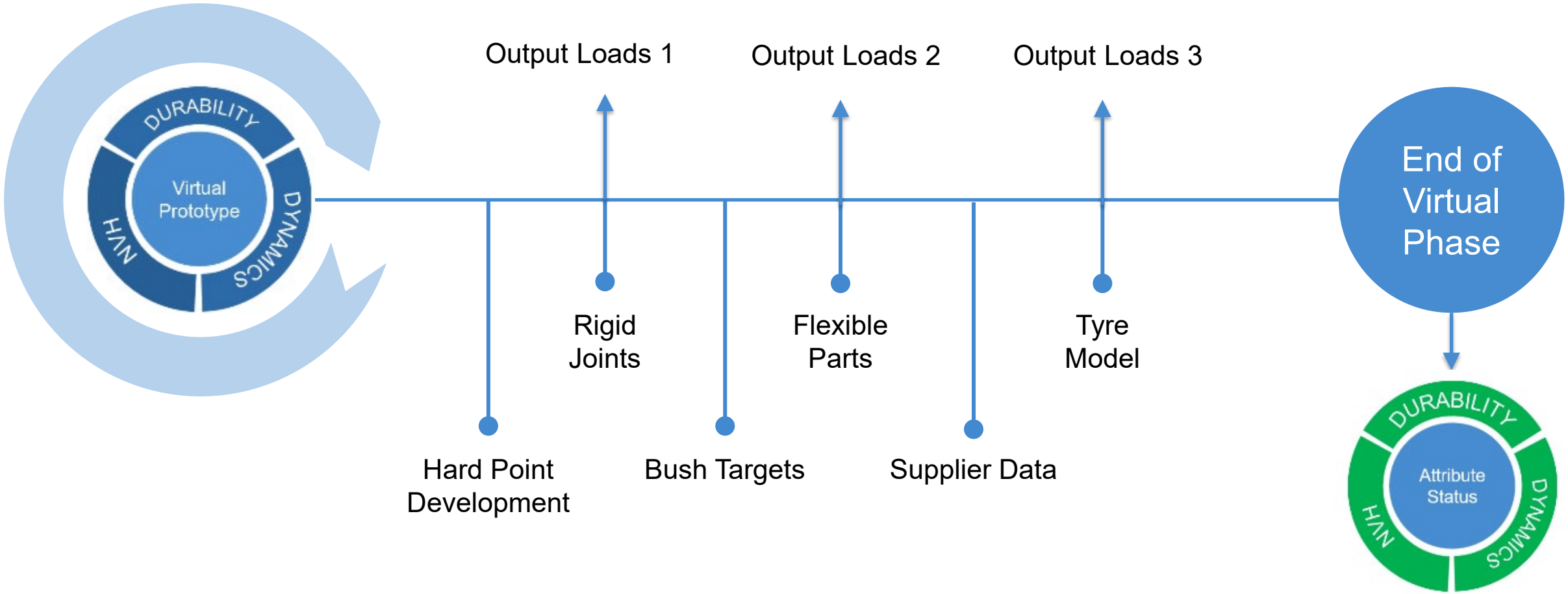


DURABILITY
- Virtual RLD
- Bolted Joint Sizing
- Ball Joint Sizing
- Strength CAE
- Fatigue CAE
- Rig duty cycles

NVH
- Benchmarking and target setting
- Chassis & body vibroacoustic optimisation
- Powertrain driveability & isolation
- Ride quality inc. shake and WBV
- Noise Simulator model generation
- Complimentary test & simulation capabilities (DVP)

DYNAMICS
- K&C development
- Driving simulators
- Full vehicle dynamics development
- EPAS Tuning
- Damper Tuning & Development
- Tyre selection
- HiL development
- SiL Development
- Active chassis systems development

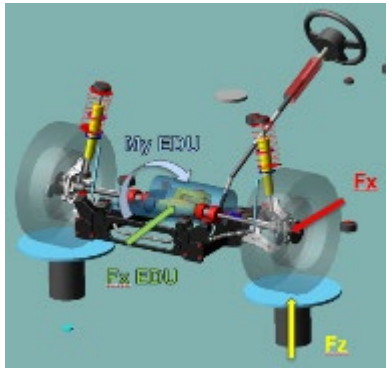
Virtual prototype life cycle



Virtual Durability Data

Step 1 - Static Loading

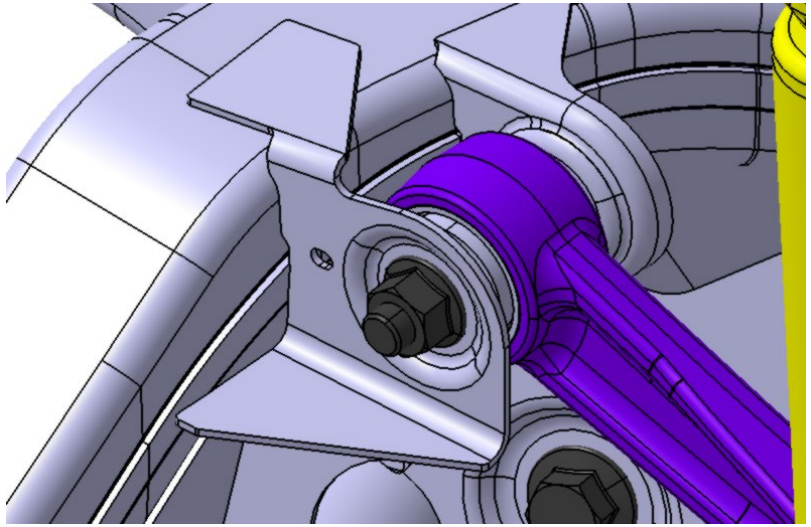
Static Events				g-factor X		g-factor Y		g-factor Z		EDU Input
Group	FA	RA	Event Description	Front	Rear	Front	Rear	Front	Rear	
Proof	11	9	Limit braking	1.1	1.1			1.0	1.0	Y
	12	10	Limit reverse braking	-1.1	-1.1			1.0	1.0	Y
	13	11	Limit acceleration	-0.6	-0.6			1.0	1.0	Y
	14	12	Limit reverse acceleration	0.6	0.6			1.0	1.0	Y
	15	13	Limit cornering RH			1.0	1.0	1.0	1.0	Y
	16	14	Limit cornering LH			-1.0	-1.0	1.0	1.0	Y
	17	15	Forward kerb strike proof	1.0	1.0			1.0	1.0	Y
	18	16	Rear kerb strike proof	-1.0	-1.0			1.0	1.0	Y
	19	17	Max bump					4.0	4.0	Y
	20	18	Max rebound (using unsprung mass)					-15.0	-15.0	Y
	21	19	Max bump and braking	1.1	1.1			4.0	4.0	Y
	22		Kerb jacking - FL wheel - 3kN ACW					1.0		
	23		Kerb jacking - FL wheel - 3kN CW					1.0		
	24		Kerb jacking - FL wheel Steered- 3kN ACW					1.0		
	25		Kerb jacking - FL wheel Steered- 3kN CW					1.0		
	26	20	Postel road braking	3.0	1.5			2.0	1.5	Y



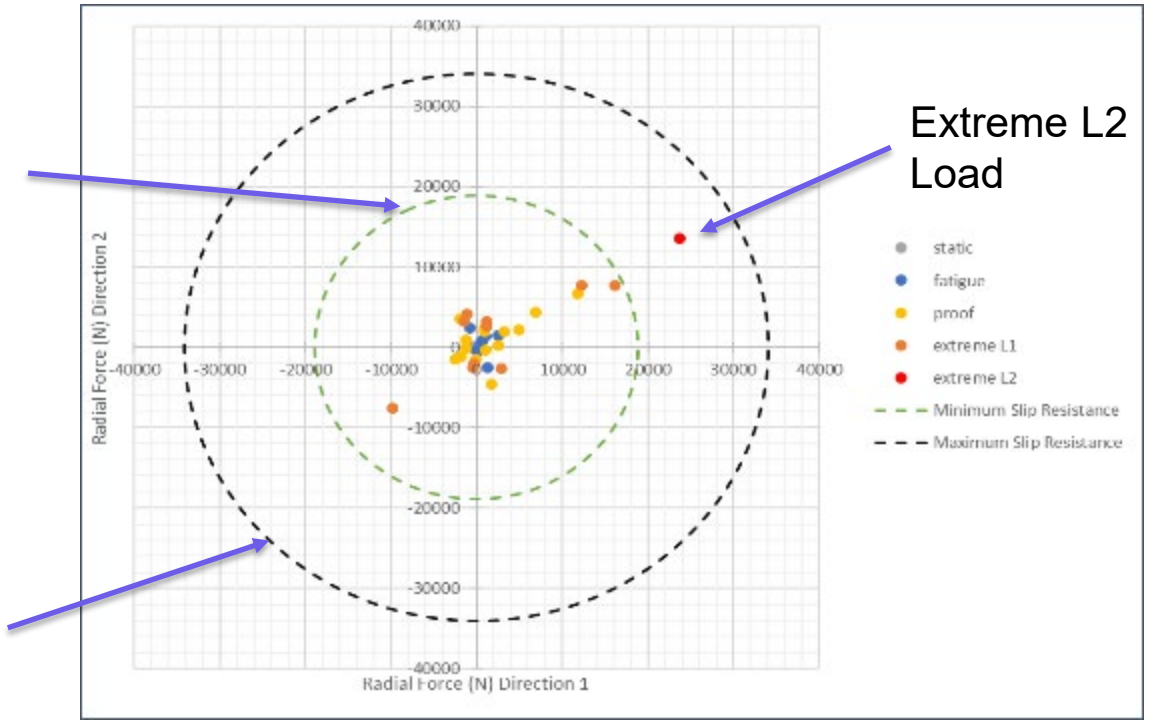
Step 2 - Virtual RLD

- Generate dynamic loads to feed into the design process
- Utilise the data for multi-axial FE fatigue analysis
- Cascade the data to suppliers for component testing
- Represents the CARDUR test procedure/target in the virtual environment

Joint sizing



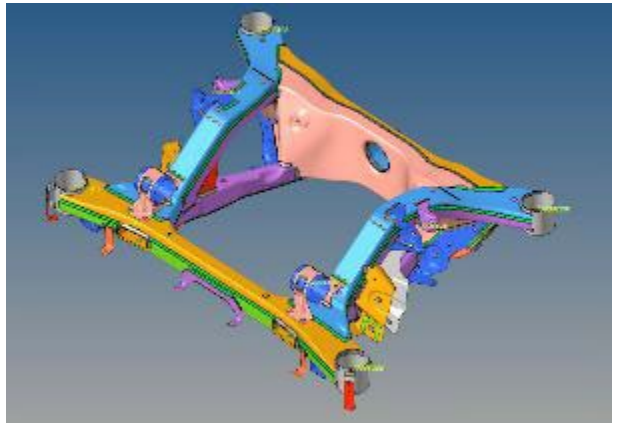
An array of wheel forces are input into the virtual prototype covering fatigue, proof and extreme loading

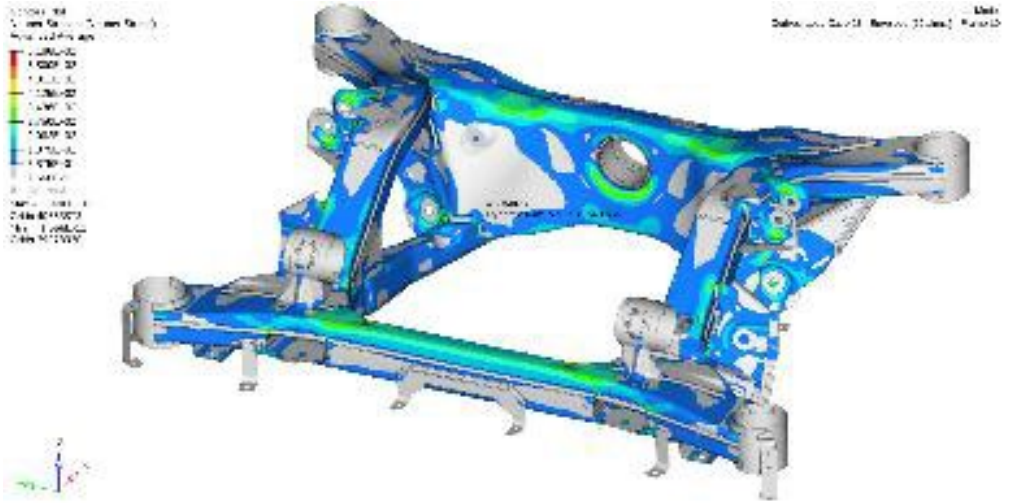


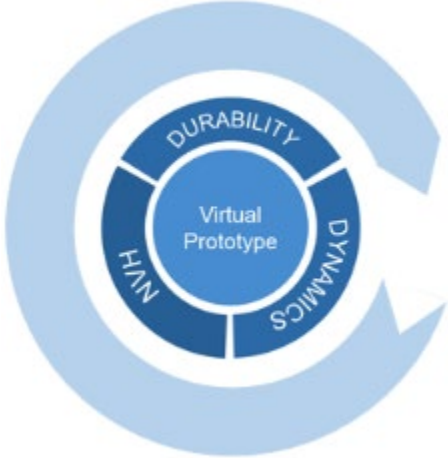
The force created at each joint are analysed and fixings selected based on various criteria including slip

FEA for strength & fatigue

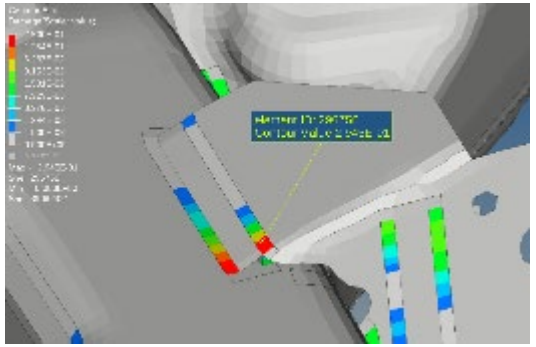
FEA was able to be completed at component and sub-assembly level allowing analysis loops to be completed with reduced processing effort







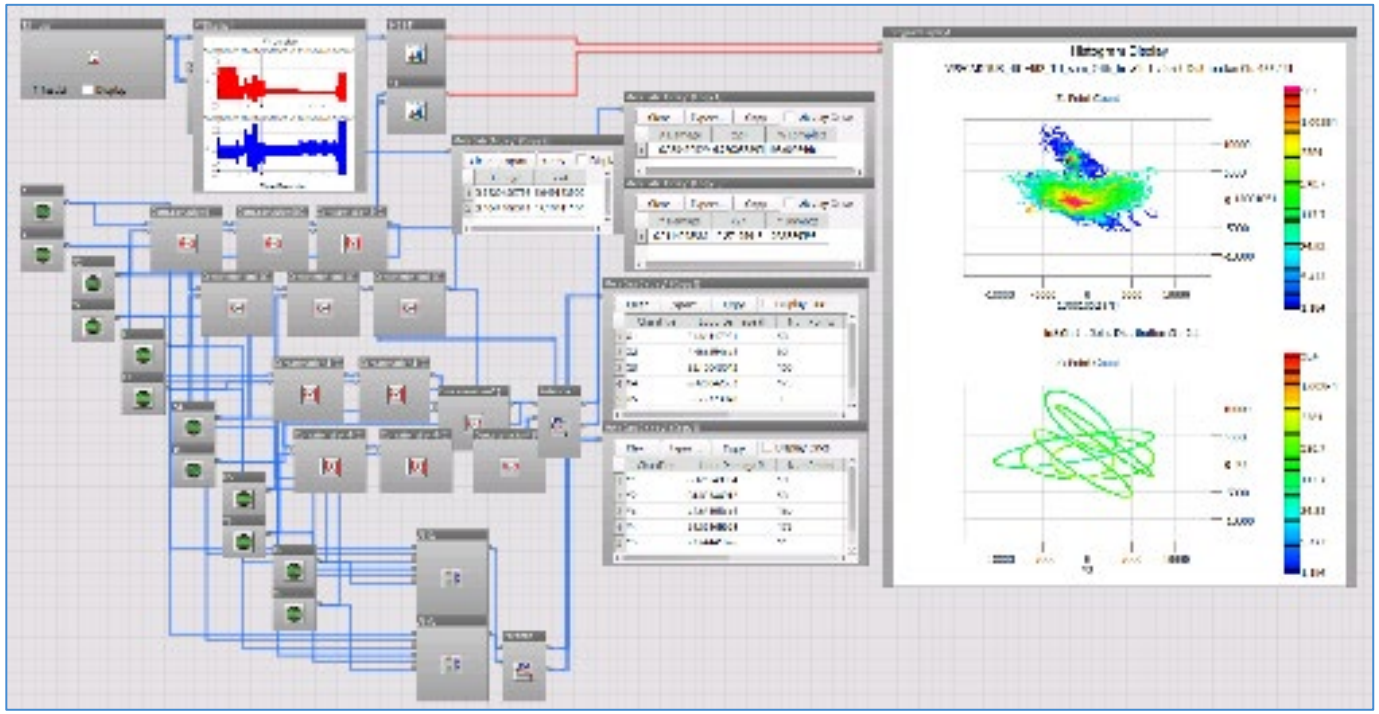
- **Modal**
- **Stiffness**
- **Strength**
- **Fatigue**

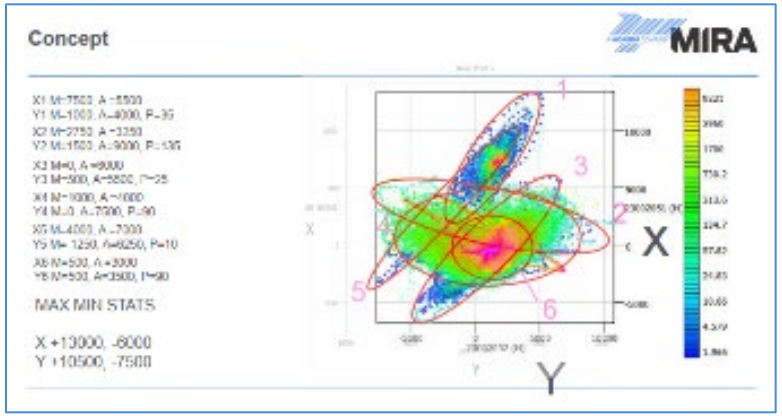


Component and system level testing

Data from the virtual prototype is used to create Strength and Fatigue Rig Tests

Component were tested using equivalent damage block cycles or dynamically from virtual RLD



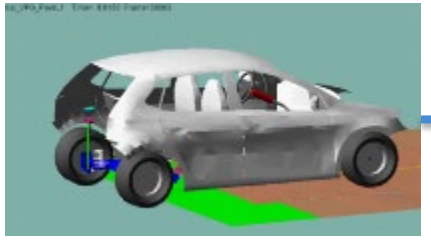


Correlation to virtual phase

All steps of data creation using a virtual prototype need a level of verification or sanity checking

Virtual Data Correlation

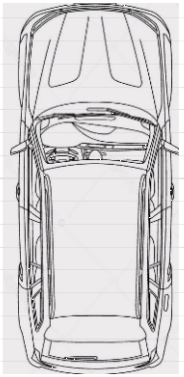
Virtual RLD



RLD Library

	VPG	MULE	RATIO
LHF_WFT_FX	18.94	80.63	4.26
LHF_WFT_FY	6.95	9.06	1.30
LHF_WFT_FZ	195.87	171.93	1.14
LHF_WFT_FV	201.69	175.24	1.15

	VPG	MULE	RATIO
RHF_WFT_FX	17.74	66.69	3.76
RHF_WFT_FY	6.62	9.74	1.47
RHF_WFT_FZ	190.01	171.05	1.11
RHF_WFT_FV	196.72	171.41	1.15



	VPG	MULE	RATIO
LHR_WFT_FX	13.53	54.95	4.06
LHR_WFT_FY	4.82	9.96	2.07
LHR_WFT_FZ	152.38	222.42	1.46
LHR_WFT_FV	157.39	218.77	1.39

	VPG	MULE	RATIO
RHR_WFT_FX	12.41	41.83	3.37
RHR_WFT_FY	4.46	9.96	2.23
RHR_WFT_FZ	147.77	201.93	1.37
RHR_WFT_FV	151.77	198.60	1.31

Confidence in the Data

Mule RLD

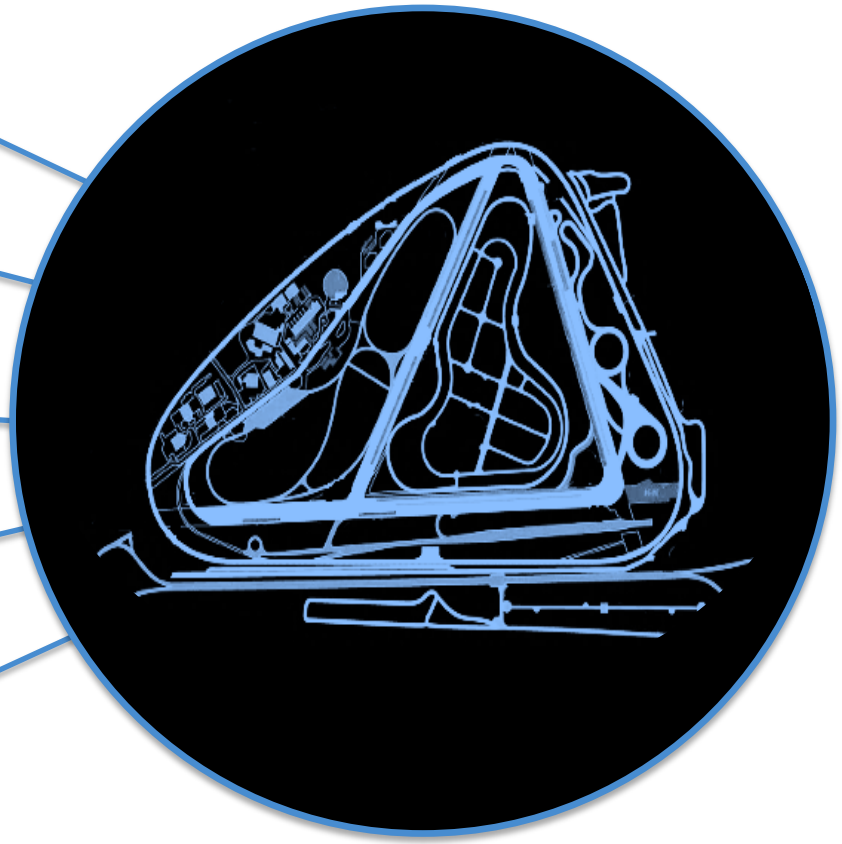
Vehicle level durability verification

The value of virtual prototyping is significant and clearly demonstrated in the previous slide.

However, the value is only fully realised when physical verification of the vehicle is complete.

Understanding the correlation between virtual and physical is fundamental to the success of the virtual tools.

- Structural
- Driveline
- Robustness
- Corrosion
- Environmental



Customer Success

HORIBA MIRA

Electric SUV Program

The virtual Prototype delivered significant benefit to the durability development by creating high confidence in the FEA results. This allowed the release of parts with long lead tooling before any physical testing and ultimately meant a shorter physical verification phase where limited durability issues were discovered.

Premium Electric Sedan

The opportunity to match MIRA CARDUR targets to our local PG allowed the OEM to use the MIRA VPG tools with a known correlation factor. This gave them a big head start and embedded the important link between virtual and physical testing. This process has now rolled into their second vehicle development strategy.

Class 3 & 4 Electric Commercial Vehicle

The virtual prototype protected the OEM during strategic changes in the development phase. The virtual data was also able to support system level testing at an early stage giving a leap in confidence for the structural durability of key systems.

Virtual Durability Development

High confidence in virtual load creation supports ambitious program timing

Virtual Prototypes run from a single model and supports cross attribute development, highlighting clashes and minimising delays

Strong correlation between attributes targets, simulation and physical phases minimises unexpected failures and costly design rework

Craig Cochrane