

A new era in Mahindra's driving dynamics

Achieving world-class dynamics performance of the new XUV700, and cutting down development time and cost using "Driving Simulator"

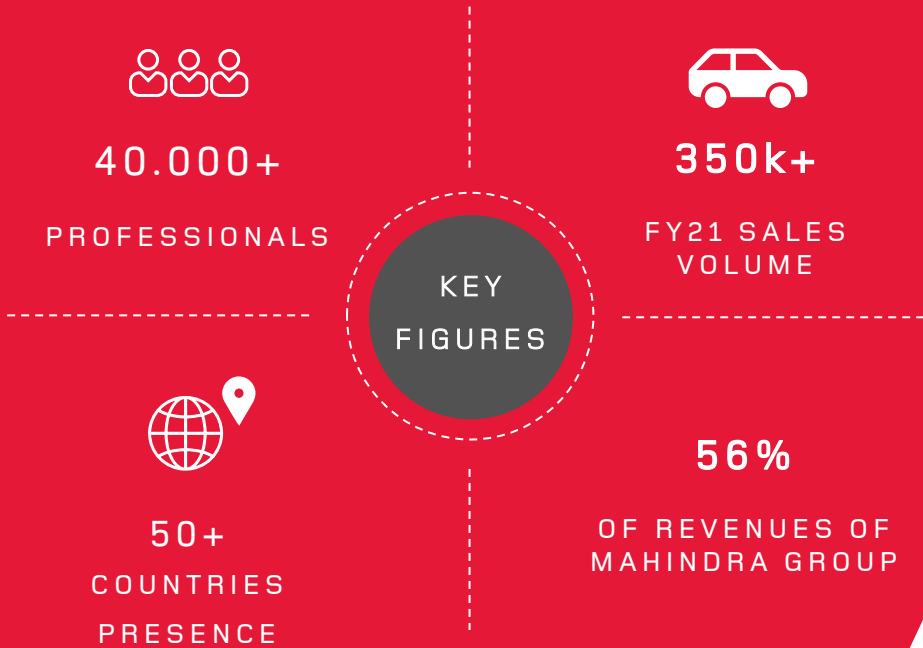


2022 ZERO PROTOTYPES SUMMIT
FOLLOW THE ROAD TO VIRTUAL SIGN-OFF
MAY 18th-19th, 2022 - UDINE, ITALY

CONTENTS

1. Companies' introduction
2. Driving Simulator-based development for XUV700
3. Key activities examples
4. Results

Part of the Mahindra Group, M&M is one of the largest vehicle manufacturers by production in India.



AUTOMOTIVE BUSINESS

OVERVIEW

PASSENGER VEHICLES



COMMERCIAL VEHICLES



ELECTRIC VEHICLES



APPLUS IDIADA

COMPANY INTRODUCTION

Applus IDIADA is an engineering partner to the automotive industry providing complete solutions for product development projects worldwide



2.675
PROFESSIONALS



FIRST CLASS
STATE-OF-THE-ART
TESTING
FACILITIES

OUR
ASSETS



22 COUNTRIES
58 LOCAL OFFICES



CONSTANT
INNOVATION
IN NEW SERVICES
AND TECHNOLOGIES

COMPLETE SOLUTIONS
FOR AUTOMOTIVE
ENGINEERING



PROJECT
MANAGEMENT



KNOW-HOW IN
ALL VEHICLE
FUNCTIONALITIES



TESTING
AND CAD &
CAE TOOLS



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XUV700 DEVELOPMENT

PROGRAM INTRODUCTION

Product intro

- All-new 7-seater SUV
- Mahindra's **flagship** vehicle product
- Launched in **August 2021**
- From **16.3 k€** to **30.2 k€**
- Front McPherson & Rear Multi-Link (blade)



Strategical project objectives



Radical improvement in vehicle dynamics performance Vs predecessor XUV500



Streamlined development process, **30 months** between kick-off and SOP.

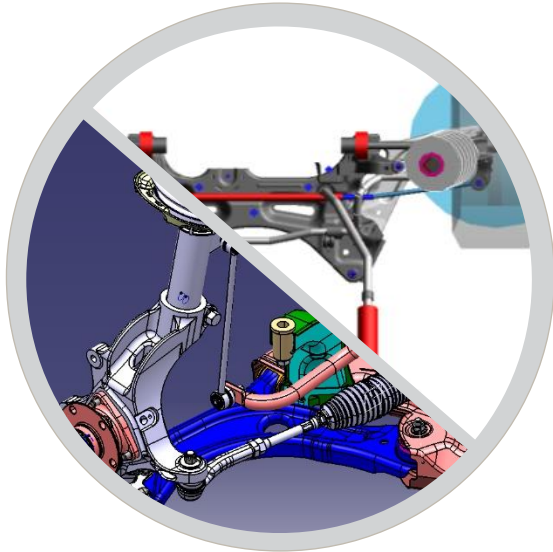


Reduce by 25% cost related with **physical** ride and handling tuning.

XUV700 DEVELOPMENT

KEY ELEMENTS FOR SUCCESS

Design led by
functionality



Physical development on
reference Indian roads



CAE-driven & simulator-
centred approach



VEHICLE DYNAMICS PROCESS OVERVIEW

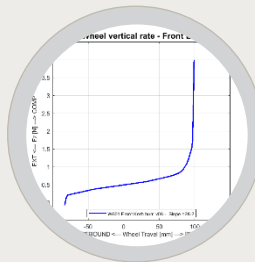
Subjective
targets



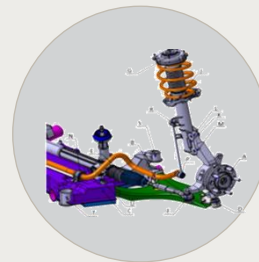
Vehicle
targets



K&C targets



Chassis design
& specs



Prototype
development



Target
Setting



Target
cascading



Optimisation &
validation

DS support per design phase:

- Target Setting and Cascading
→ 4 days (2 sessions)
- Hardpoint freeze
→ 9 days (3 sessions)
- Design freeze
→ 9 days (3 sessions)

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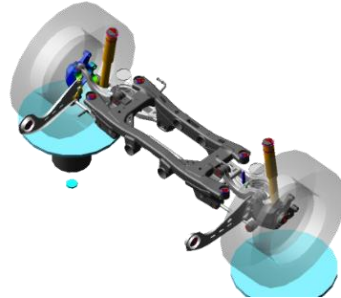
XUV700 DEVELOPMENT

KEY ACTIVITIES EXAMPLES

REAR HARDPOINT FREEZE

Problem statement

- Three candidates for rear hardpoints
- Inconclusive analysis based on off-line simulations



Results

- ✓ Decision taken on DS confirmed during physical prototype tuning (same driver).
- ✓ Fast decision-making process.
- ✓ No need to build prototype parts.

Activities

- Generate VI-CRT model of each candidate.
- Quick tuning of each candidate
- Evaluation of pros & cons and decision taken based on expert driver's judgment



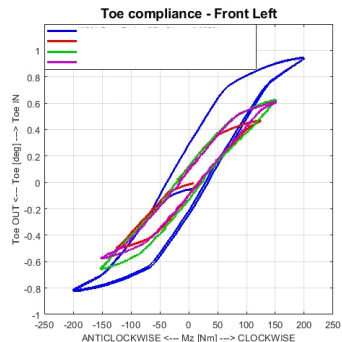
XUV700 DEVELOPMENT

KEY ACTIVITIES EXAMPLES

STEERING SYSTEM DEFINITION

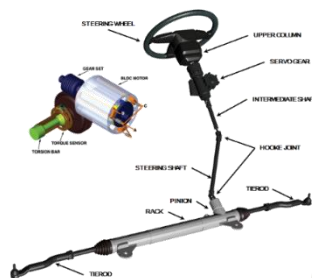
Problem statement

- Major weakness identified in **steering system** stiffness
- Significant extra-budget required to improve current component.



Activities

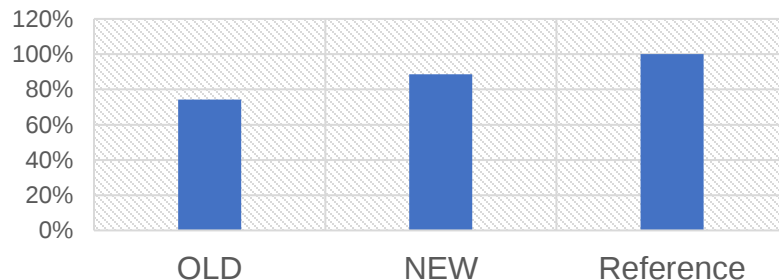
- Generate VI-CarRealTime models (current Vs improved steering)
- Organise ad-hoc session on IDIADA's DiM250 with Mahindra's product development head.



Results

- ✓ Top management approved extra-budget for steering system design modification.
- ✓ Significant improvement confirmed during physical tuning (back-to-back comparison original Vs new)

Steering stiffness



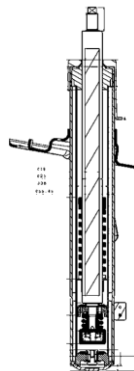
XUV700 DEVELOPMENT

KEY ACTIVITIES EXAMPLES

DAMPERS FORCE-VELOCITY CURVES OPTIMISATION

Problem statement

- Initially proposed dampers construction impose sub-optimal force-velocity curves
- Need to clarify new F-V targets to supplier
- Need to evaluate supplier's proposed solutions.



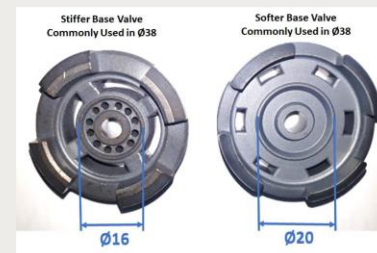
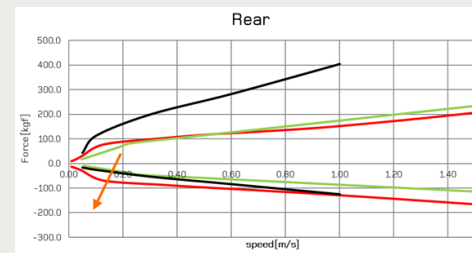
Activities

- 1st session → F-V target curves
- 2nd session → virtual damper tuning, based on available design workspace



Results

- ✓ Definition of starting point for physical prototype tuning
- ✓ Definition of required tunability ranges for damper tuning
- ✓ Selection of required damper technology based on cost-performance balance
- ✓ Final dampers similar to DS specification



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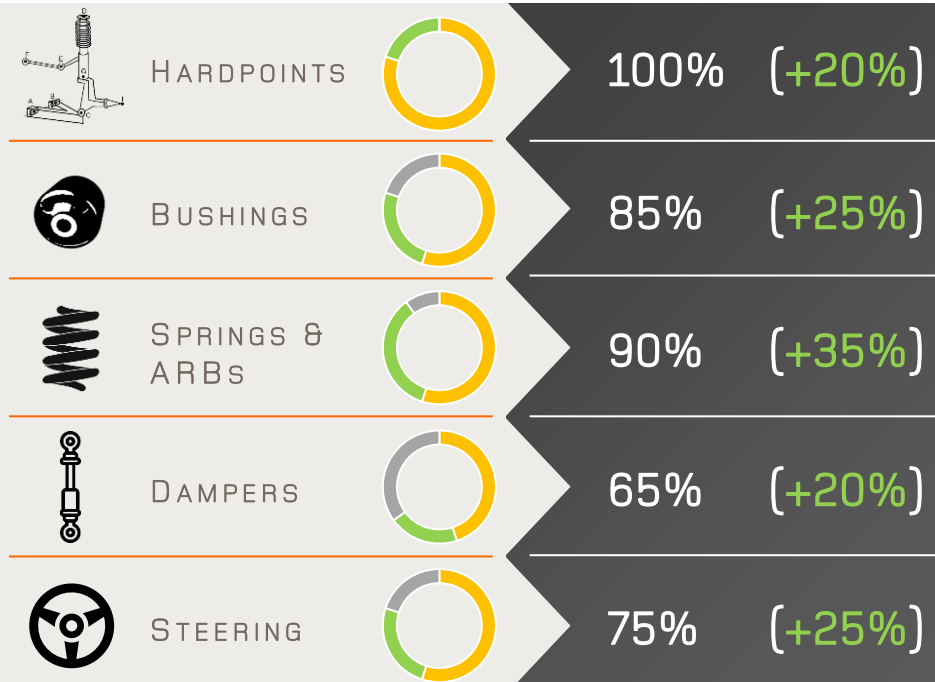
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XUV700 DEVELOPMENT

DRIVING SIMULATOR IMPACT

MATURITY LEVEL VS FINAL SPECS

■ Off-line CAE ■ Driving Sim ■ Testing



SUMMARY

22

Days on DiM250

450+

Set-ups evaluated

~35%

Tuning time reduction
(for same performance
level)

~30%

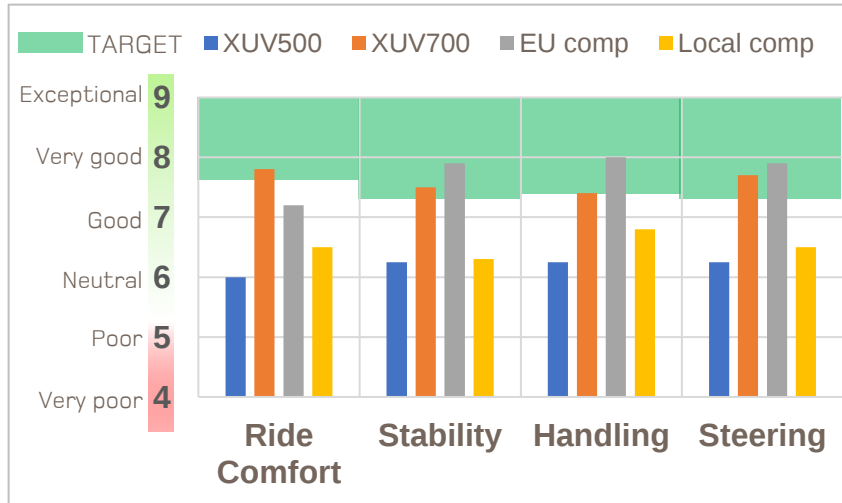
Reduction in
prototype parts for
long lead items

XUV700 DEVELOPMENT

RESULTS: MARKET ACCEPTANCE

INTERNAL EVALUATION

Summary of jury evaluation with expert evaluators and Mahindra's top management (March 2021):



EXTERNAL EVALUATION



Car of the year 2021
50k bookings in 3 hours
Enthusiastic customer's and press feedback

AUTOCAR
INDIA

"The biggest area of improvement over the XUV500 is the dynamics."
[...]

"The key to the XUV700's transformed ride and handling is the suspension system."

What is good and bad in XUV700?

ZIGWHEELS.COM



XUV700 Positives

Sharp design elements, comfortable ride quality, clean dashboard layout, powerful drivetrain options, AWD & diesel options.

XUV700 DEVELOPMENT

CONCLUSIONS & NEXT STEPS

CONCLUSIONS

Success story for a complete development program

DiM250 simulator was a key element to achieve project's targets

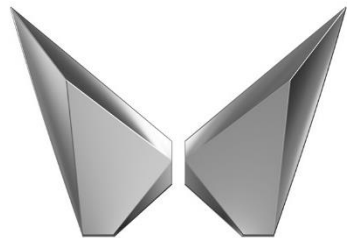
Optimised budget **AND** higher performance

NEXT STEPS

Integration of tyre development on the simulator

ECCS development on the simulator (dual motors
AWD strategy for EV)





T H A N K Y O U F O R Y O U R K I N D A T T E N T I O N



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