

Complete chassis development with
driving simulators

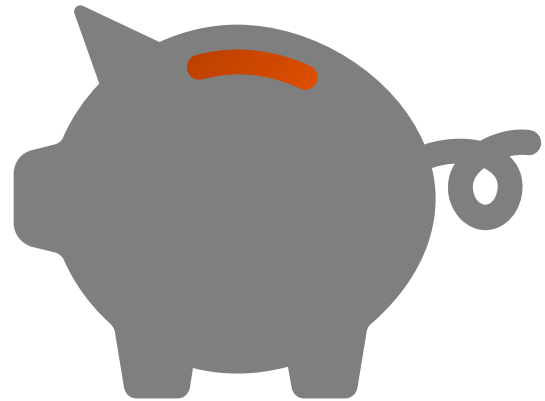
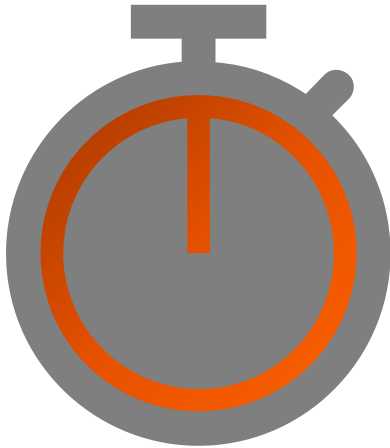
How much time and money can be really
saved?



CONTENTS

1. Introduction
2. Case study: new platform development
3. Bridging the gap further
4. Conclusion

How much **time** and **money** can be really saved with driving simulators?



ZPS 2022



Complete development of
a new SUV.

22

Days on DiM250

450+

Set-ups evaluated

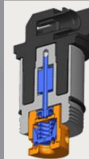
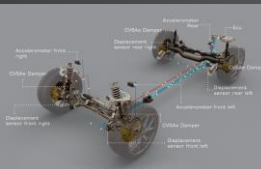
~35%

Tuning time reduction
(for same performance
level)

~30%

Reduction in
prototype parts for
long lead items

ZPS 2023



Semi-active dampers
development.

(physical) vs. simulator

(15+) 6

Days of evaluation

(~30) ~35

Set-ups evaluated

(40+) 0

Physical dampers
components

46%

Time saving for
tuning

INTRODUCTION

THE WRONG ANSWER

Common mistakes

1. Compare daily cost of Driving Simulator testing Vs Track testing
2. Consider only the time and budget saved for testing

→ There is much more than this!



INTRODUCTION

THREE KEY AREAS

x6 faster



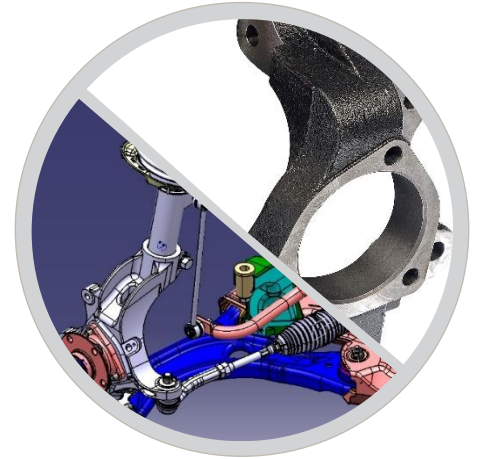
In average, 6 times more set-ups can be evaluated in a day

Less testing



Less time required for tuning and validation on PG and public road.

Less protos



Lower number of prototype vehicles and prototype parts.

CONTENTS

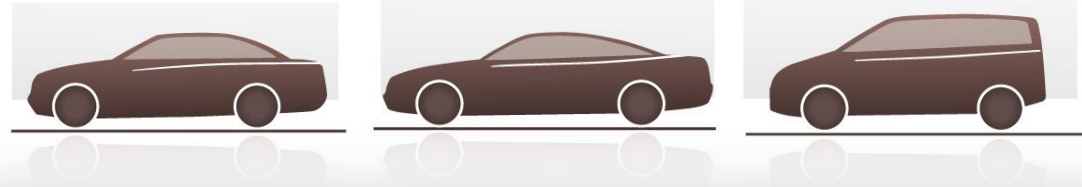
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CASE STUDY

INTRODUCTION

Vehicle dynamics development for new vehicle platform:

- Three vehicles
- Two variants (RWD & AWD)
- Passive chassis



Scenario 1: without driving simulator

Assumptions:

- Robust off-line CAE process
- 4 physical prototypes loops: MULE → PT1 → PT2 → PS
- Cost of PT vehicles and parts, based on reasonable assumption.

Scenario 2: with driving simulator

Assumptions:

- Robust off-line CAE, process integrated with DS process
- Use of DiM250: 40 days
- 3 physical prototypes loops: ~~MULE~~ → PT1 → PT2 → PS

1. Tuning & Validation activities

Based on previous project experience:

- Define physical tuning and validation plan for both scenarios (**with** and **without** simulator):
- Estimate costs related with:
 - Proving Ground
 - Testing and Tuning engineers
 - Workshops and mechanics
 - Instrumentation and test rigs
 - IDIADA's Driving Simulator use



2. Prototype vehicles and parts

Based on reasonable assumptions:

- Define quantity of physical prototype vehicles and parts required for both scenarios (only for VD development):
- Estimate costs related with:
 - Mule vehicles manufacturing
 - Prototype vehicles manufacturing
 - Tuning parts development and manufacturing

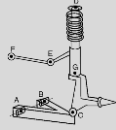


3. Comparison (with Vs without simulator)

- Compare time, resources and parts
- Compare total cost
- Analyse breakdown of saving

CASE STUDY

RESULTS: TIME, RESOURCES AND PARTS

	Tuning (weeks)	Mule vehicles	PT/PS vehicles	Metal parts	Bushes & stopper	Springs & ARBs	Damper tuning (weeks)	Tyre specs
								
	48	2	18	86	124	128	18	74
	30	0	15	44	74	60	14	44
	-37%	-100%	-17%	-48%	-40%	-53%	-29%	-41%

Comparison: with Vs without driving simulator

Cost of physical development for VD

85 M¥

Without driving
simulator

Vs

55 M¥

With driving
simulator

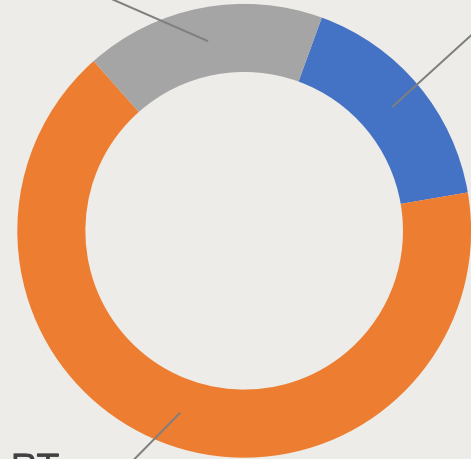
-35%

Cost reduction for
physical development

1:9 ROI

1¥ spent in simulator saves 9¥
in physical development

Cost reduction breakdown

Less PT
parts
17%Less
testing
17%Less PT
vehicles
66%

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KEY AREAS FOR FURTHER COST OPTIMISATION

1. Detailed evaluation of ride comfort

-  Improved ride Vs Handling balance
-  Integration of Real-time high-fidelity models.
-  Additional motion cues in the cockpit (shakers, etc)

2. Electronic chassis controls

-  More efficient integration of chassis controls
-  Library of behavioural models for early-stage (target cascading)
-  Detailed models of logic and actuators from the suppliers (pre-calibration)

3. Functional Safety

-  Perform Hazard Analysis and Risk Assessment (no vehicle available)
-  Validation of scenarios that would be nearly impossible to test in the real world
-  Definition of test scenarios within the DS environment

4. Automated Driving

-  Evaluation of user acceptance and interaction, also with “naïve” drivers.
-  Validation of scenarios that would be nearly impossible to test in the real world
-  Strong support from Human Factor teams

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CONCLUSIONS & OUTLOOK

CONCLUSIONS

The driving simulator makes it possible to save very significant amount of time and money for chassis development activities.

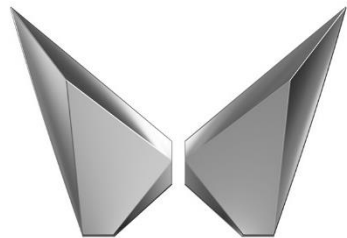
The cost saving is mostly related with the reduction of prototype vehicles and tuning parts.

The additional economical effort required by the simulator is largely compensated by the reduction of time and budget in the physical development.

OUTLOOK

There is still a lot of margin to further optimise costs and time: especially in the domain of **electronic chassis controls** and **automated driving**.





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