



PDE Automotive

Shift Quality Analysis Tool



CONTENT (1)

1 Introduction

2 PDE testing, T/M calibration

3 Shift Quality

Shift Comfort

Definitions

G-sensor signal

4 Shift Quality Tool

Evaluating method of vibrations

Model

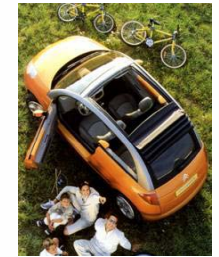
Validation

5 Summary

Advantages / Restrictions

Future developments

Automotive History



1958

1975

1992

4/2001

PDE Locations / Local Offices



Head office, Helmond



Test Centre, Helmond

PDE: 1.000 staff in 14 locations

+

world-wide presence through
Benteler locations in more than
52 locations in 22 countries

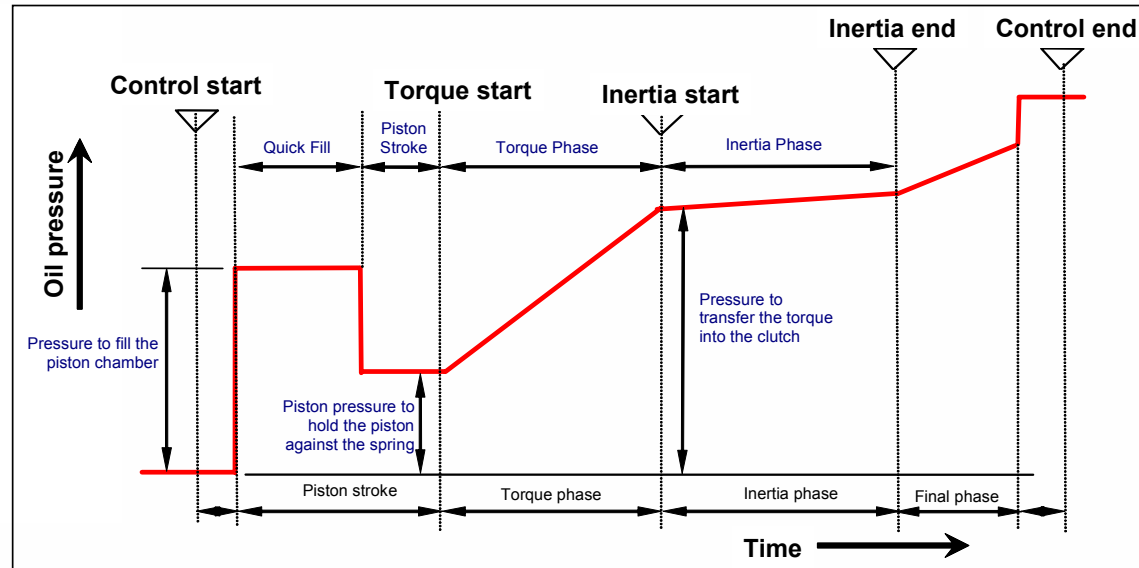
Powertrain & T/M reference projects

- **Volvo Cars Sweden**
 - Driveline Tuning for AT (XC90, S80)
 - Complete vehicle evaluation on S40/V50
- **Getrag 4wd MINI**
 - Integration/packaging of 4wd system MINI
 - Development of new rear subframe
 - Prototype building
 - Optimization of vehicle dynamics
- **APTS Phileas Hybrid**
 - Engine installation including cooling package
 - NVH optimization
 - Hybrid control system development



Calibration process

- Specialist job
- Time consuming
- Data processing
- Expensive
- Subjective judgments



Need for : simple and fast measurement processing & judging !!

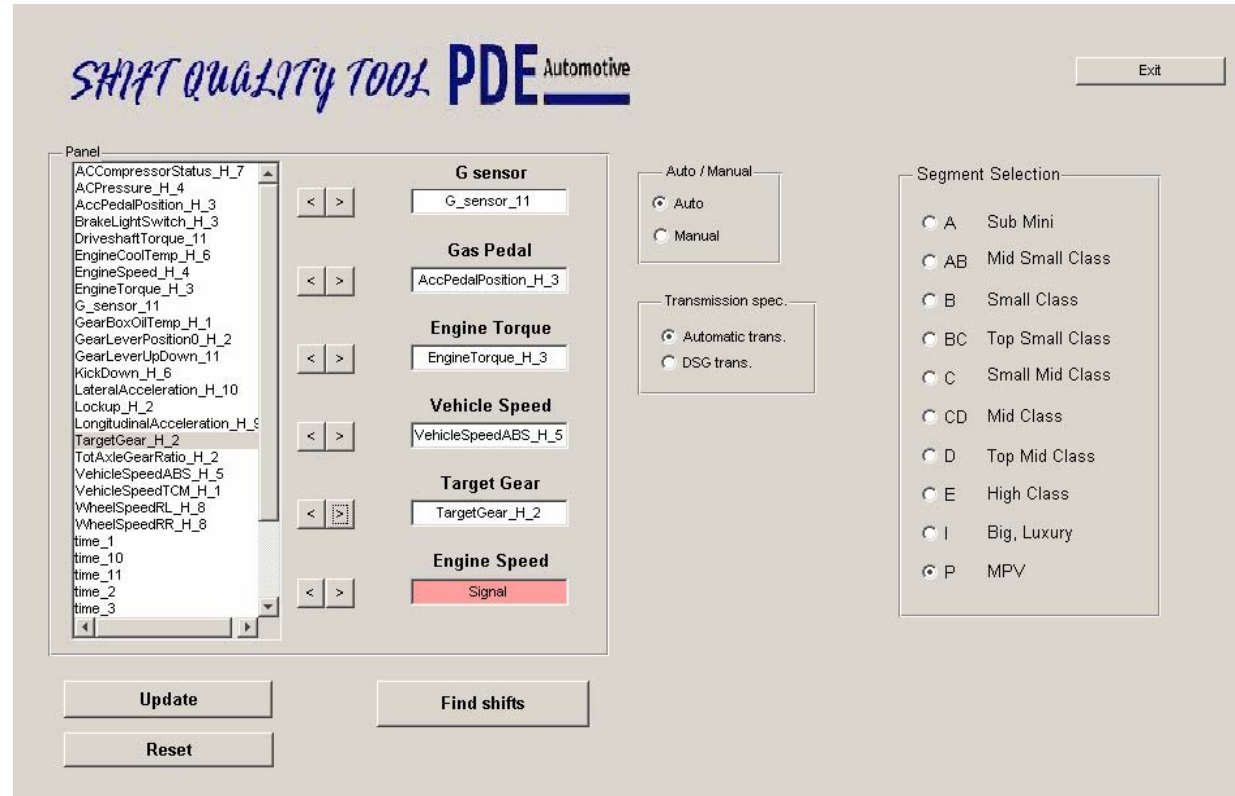
Shift Quality Analysis Tool

Shift Quality Tool

SQT Objective : Find a way to convert a measured shock into a judgment of shift quality

and additionally :
take into account

- **Shifting type**
- **Transmission type**
- **Car Segment**





CONTENT (2)

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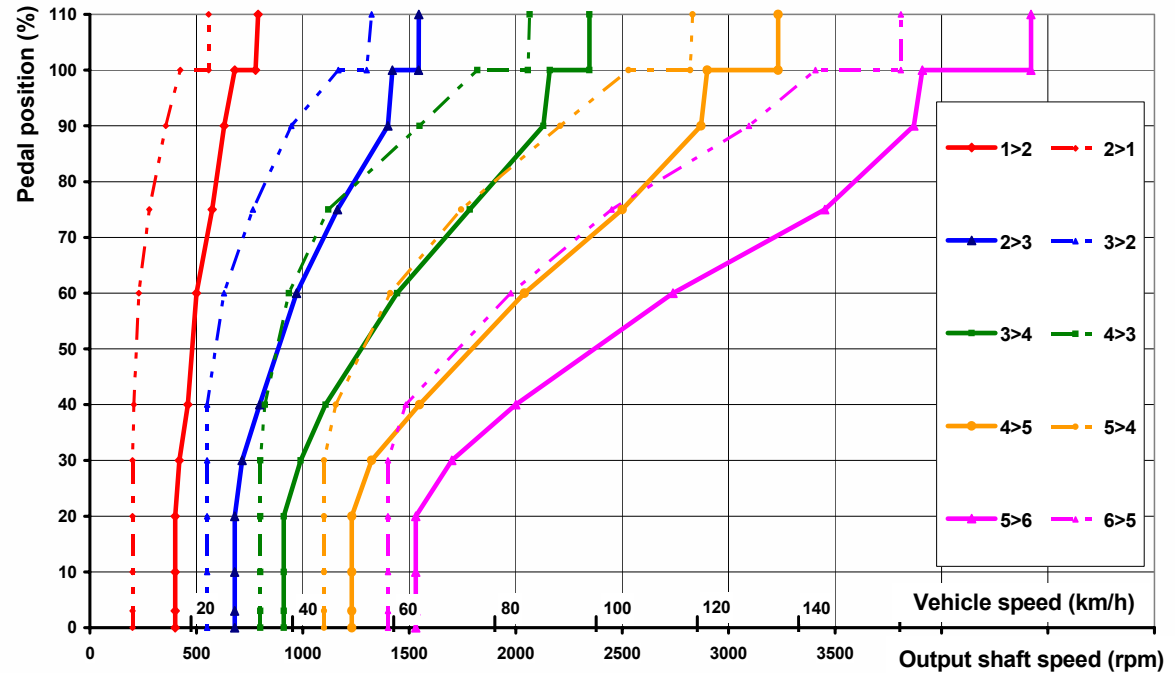
Advantages / Restrictions

Future developments

SQT Shift Quality Tool

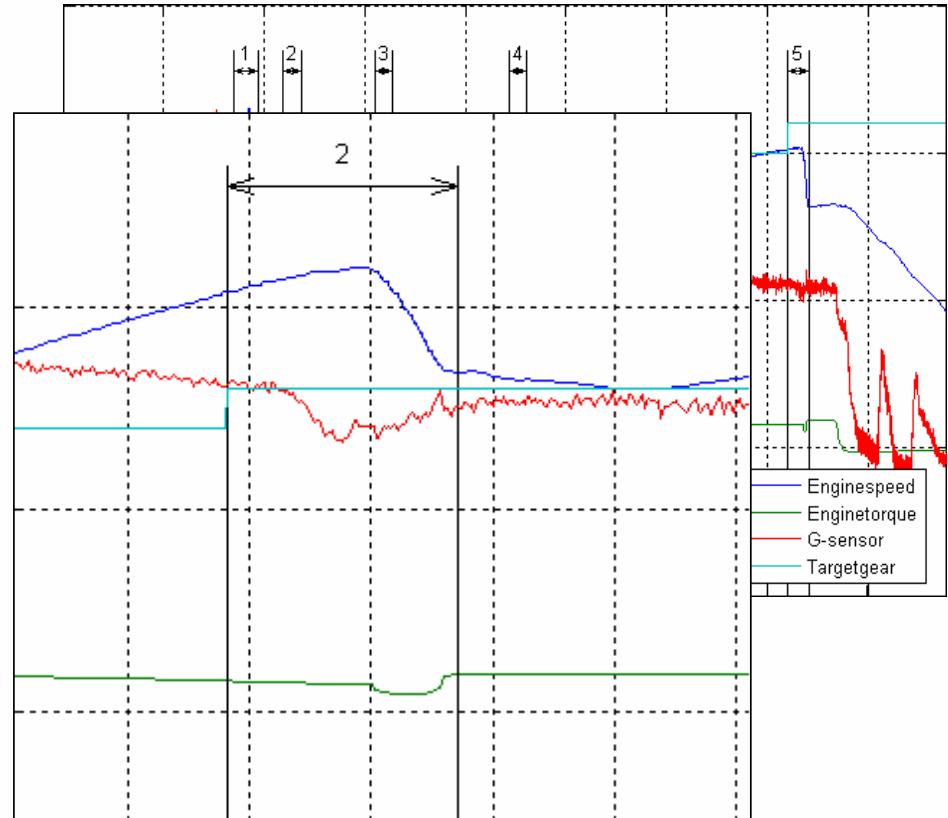
Shift comfort items

- Acoustics
- Engine response
- Shift diagram
- Shift time
- Shift Quality (shock)



Definitions

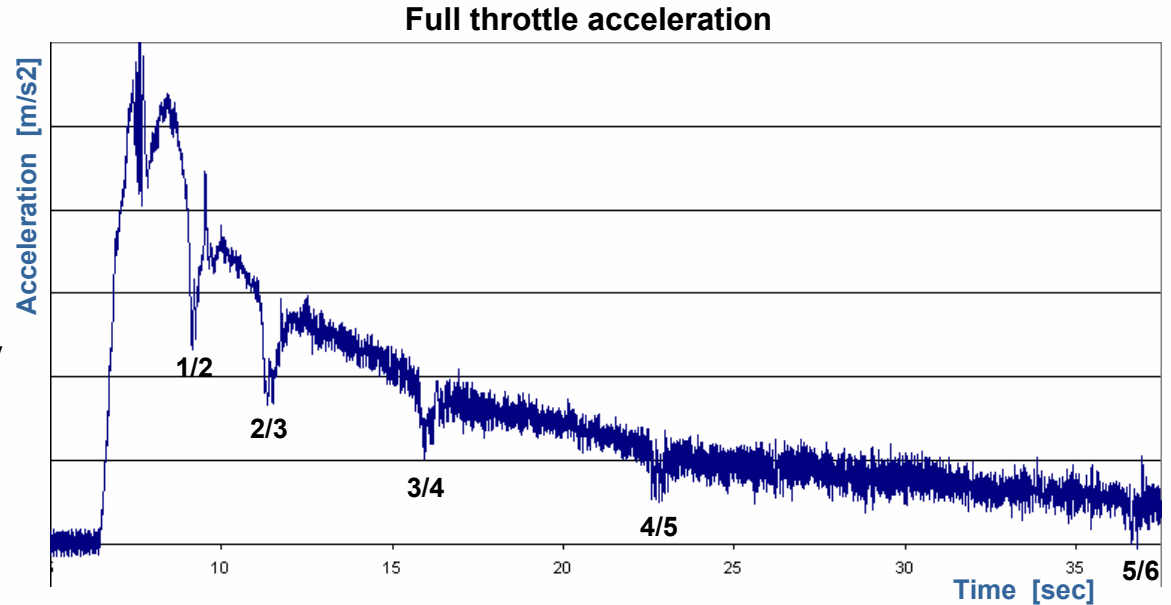
- Total ratio
 - Engine speed [—]
 - Vehicle speed
- Engine torque [—]
- Target gear [—]
- Throttle position
- G-sensor signal [—]



SQT Shift Quality Tool

G-sensor signal

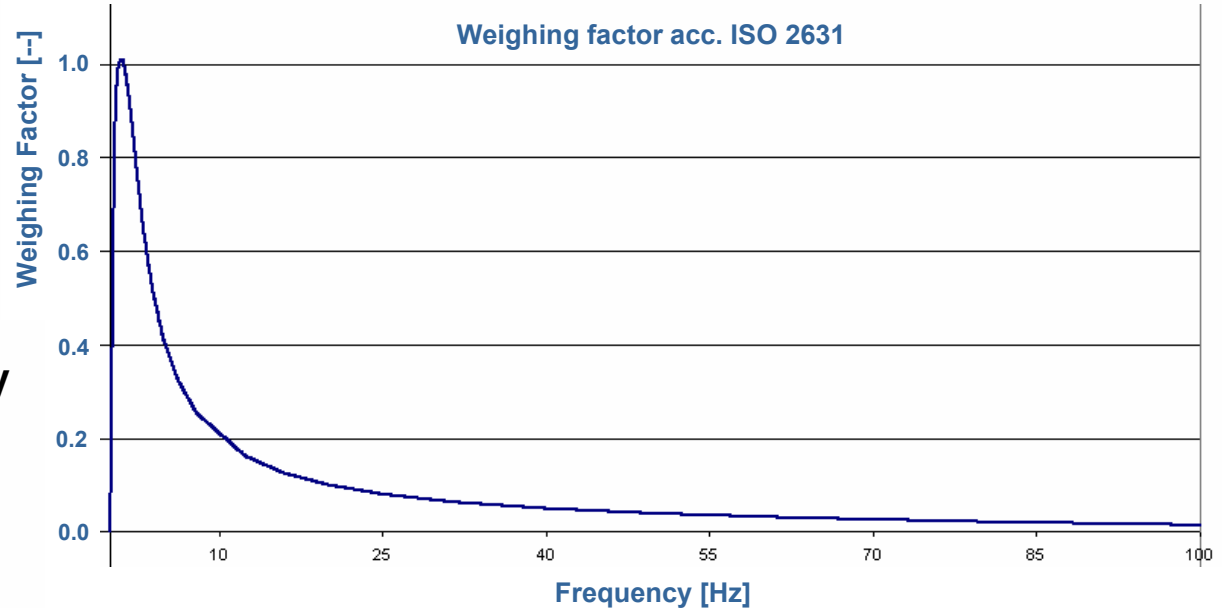
- Noise
- Avg. vehicle acceleration
- Human sensitivity



SQT Shift Quality Tool

G-sensor signal

- Noise
- Avg. vehicle acceleration
- Human sensitivity

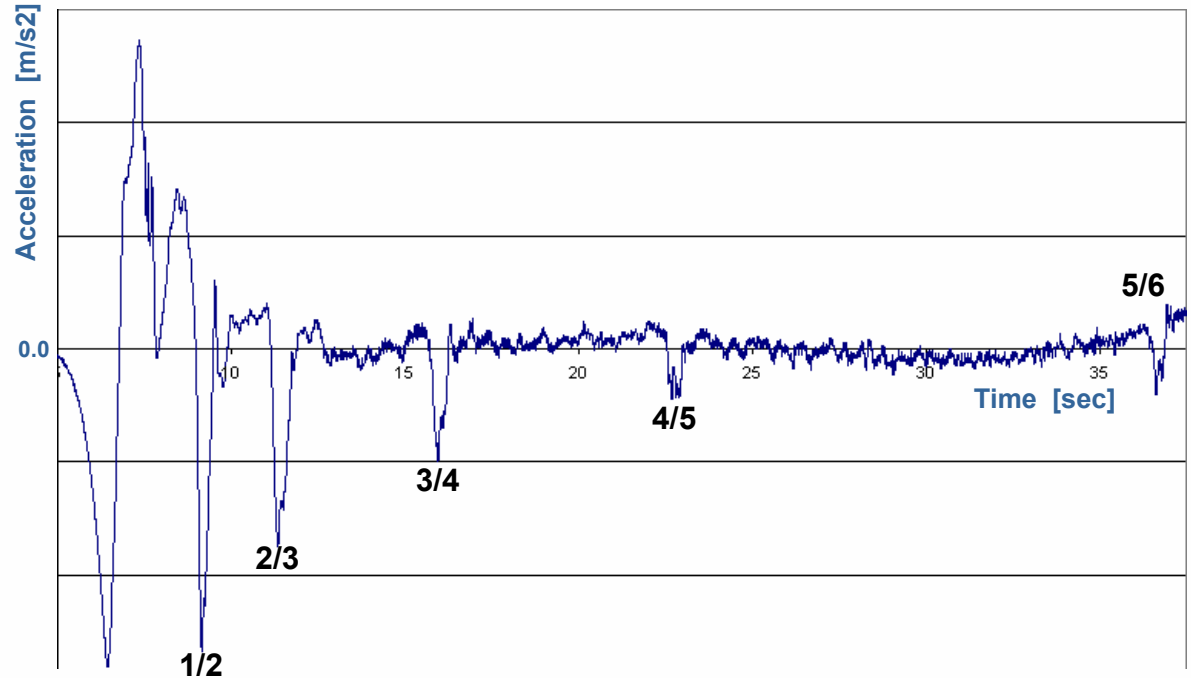


**Assessment and Control of Whole-Body Vibration
(ISO 2631)**

SQT Shift Quality Tool

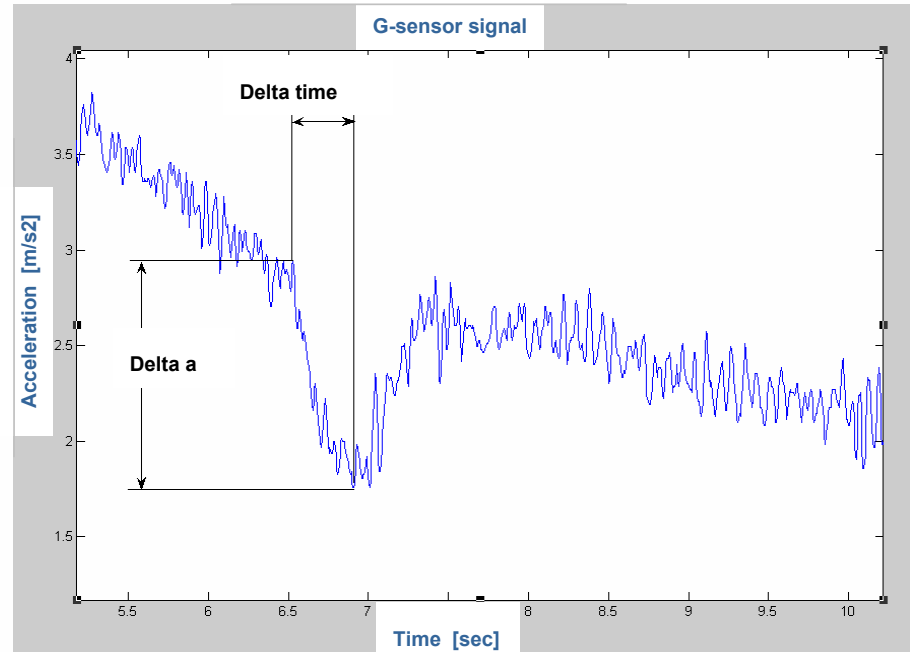
G-sensor signal

- Noise
- Avg. vehicle acceleration
- Human sensitivity



Evaluating method of vibrations

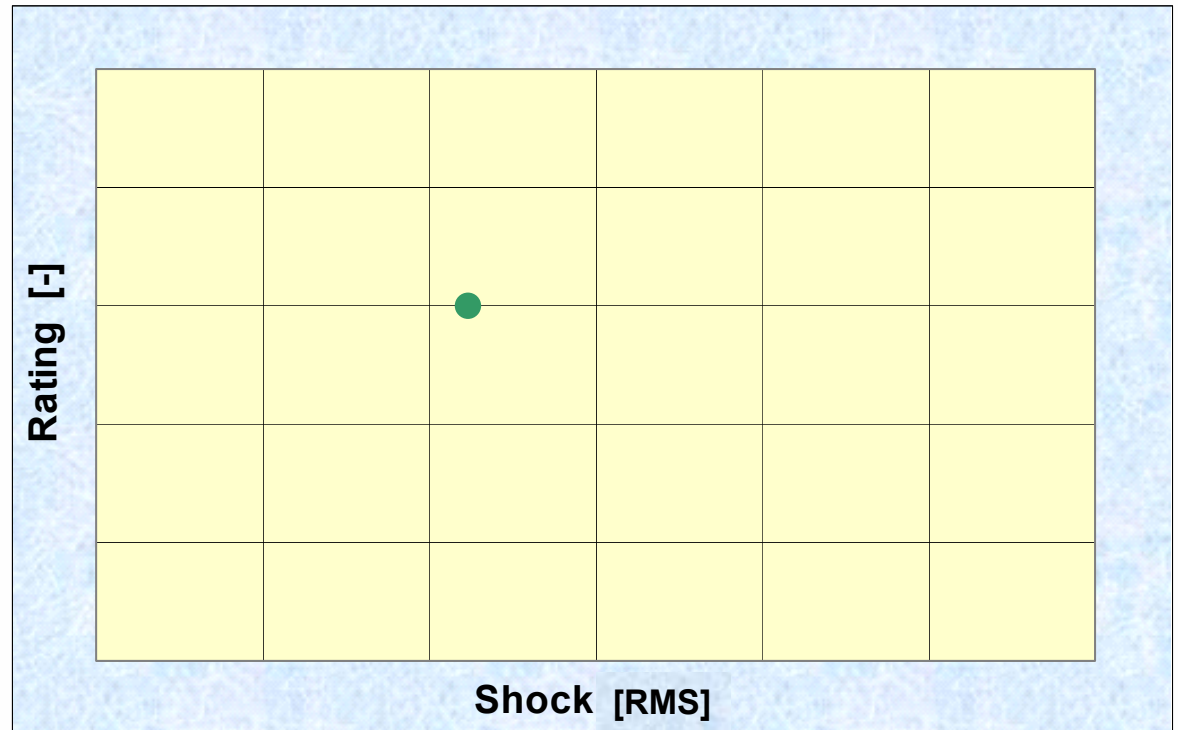
- Determination of shock intensity
- $RMS = \left[\frac{1}{T} \int_0^T a_w^2(t) dt \right]^{\frac{1}{2}}$
- $VDV = \left[\int_0^T a_w^4(t) dt \right]^{\frac{1}{4}}$
- Crest factor > 9 = VDV method



SQT Shift Quality Tool

Model

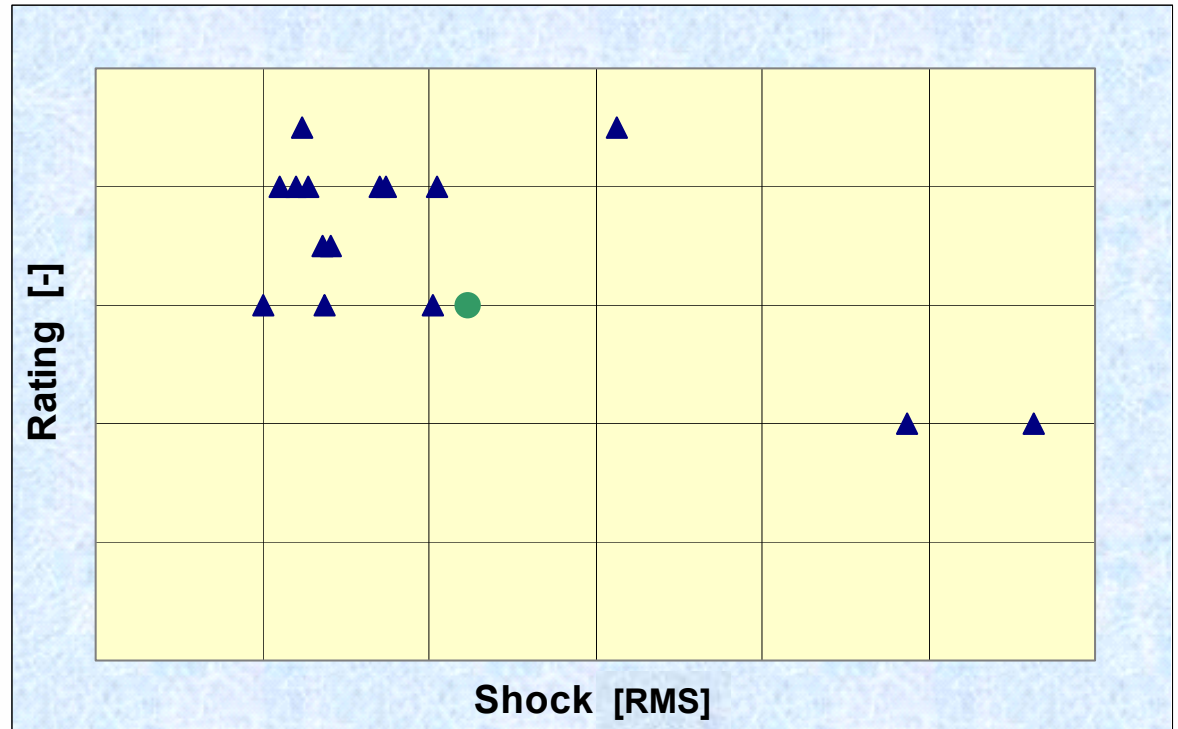
- Trend line
 - Calculated from a lot of measurements
- Foundation



SQT Shift Quality Tool

Model

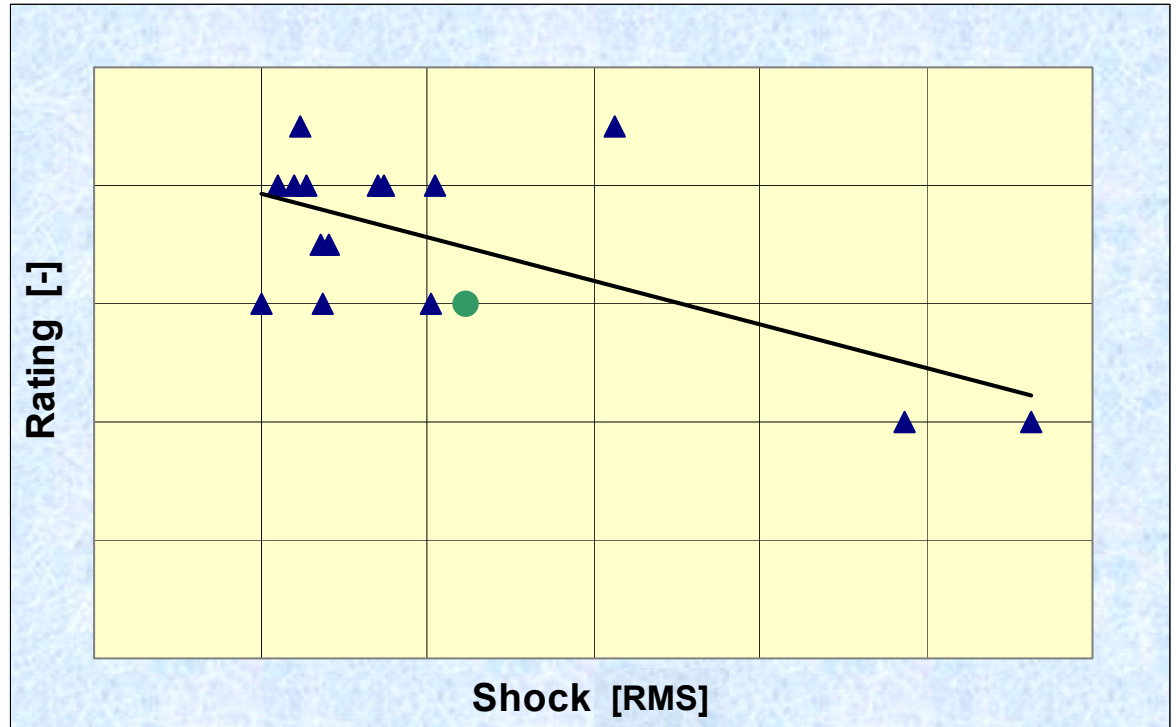
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SQT Shift Quality Tool

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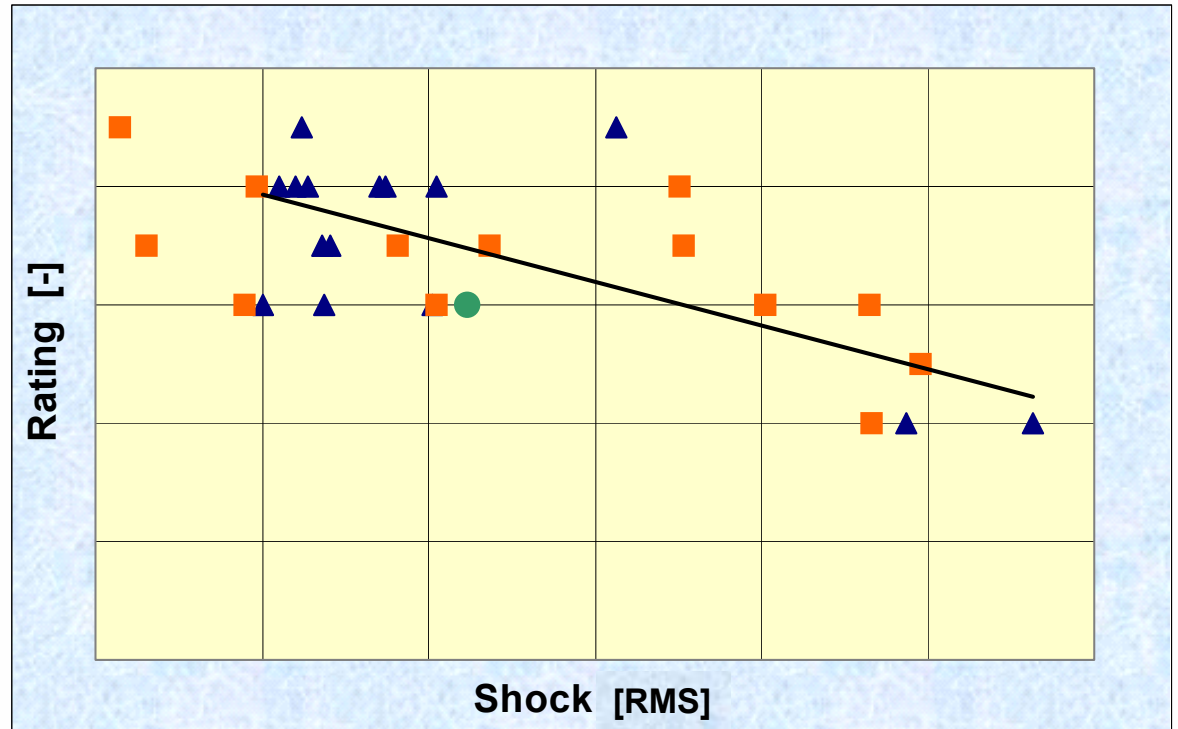
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SQT Shift Quality Tool

Model

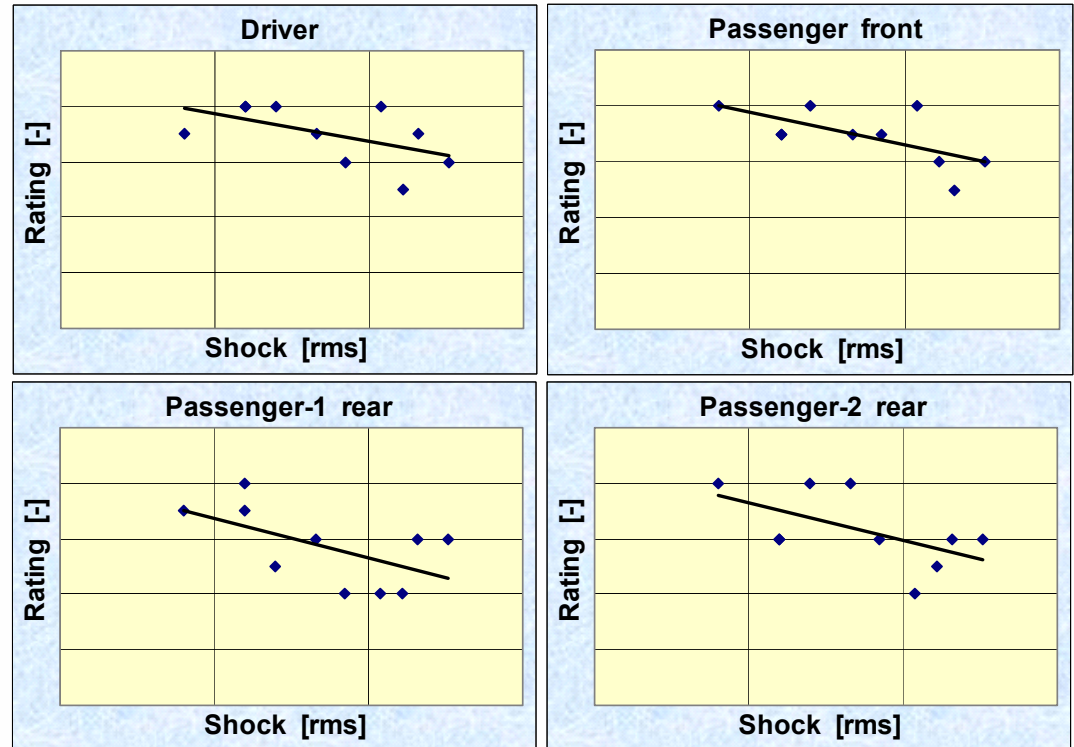
- Trend line
 - Calculated from a lot of measurements
 - Foundation
- Database
 - Flexible
 - Accurate



Validation

- Objective :
prove the relation
between rating and rms.
- 2 experts,
2 consumers
 ➔ 4 relations

Power on upshift judgment



Advantages / Restrictions

+ Objective judgment

Accurate

Reproducible

Quick

Time and money saving

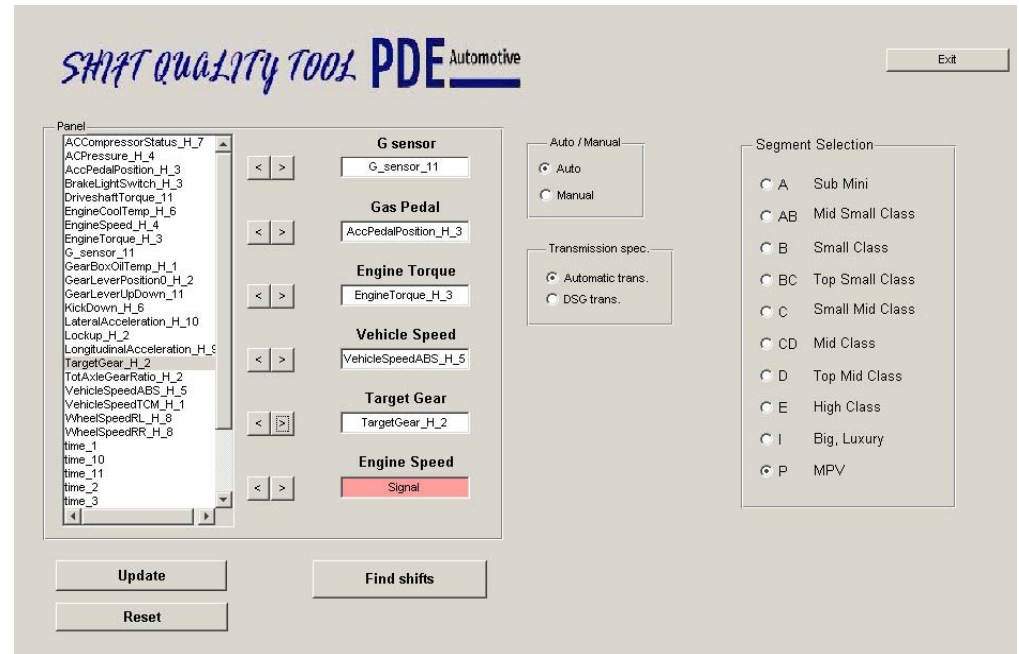
– There's more to judge but the shock,

>> ***shift shock is part of overall shift comfort***

SQT Summary

Future developments

- More transmission types
 - AMT
 - DCT
- More shift types
 - Power off upshifts
 - Garage shifts
- Link to a complete driveline simulation package





PDE Automotive

Thank you for your attention!