

MODUS expertise

MAIN ACTIVITY : VALIDATION & DURABILITY TESTING

Complete vehicle validation in the real world by testing process.

- **SYSTEM VALIDATION** of total vehicle
- **MODULE VALIDATION** of modules & components

SPECIAL METHOD : PISTE[®]

Permanent Integrative Simultaneous Testing in Europe

OBJECT : Passenger cars, motorbikes & light commercial vehicles. Production, pre-production & prototype vehicles.

CLIENT BENEFIT : Anticipatory analysis of product quality & reliability by neutral, highly specialized experts, evaluators & engineers

- ⇒ increased efficiency & reduced warranty costs ;
- ⇒ increased customer satisfaction.

ASSETS : STAFF MINDED

- Integrative
- Anticipative
- Creative

NEUTRAL
 METHODS – PISTE process
 FLEXIBLE
 ADAPTIVE
 EXPERIENCE

CHALLENGES :

- Business / work load fluctuation
- Few amount of clients
- Management of small company in global environment

MODUS COMPANIES

Permanent facilities :

- | | | |
|-------------------------|-----------------|--------------------------------------------------|
| 1. MODUS HISPANICA S.L. | SPAIN | Conil (head office)
Jerez, Mojacar (branches) |
| 2. MODUS HISPANICA S.L. | GERMANY | Wiesbaden-Igstadt (branch) |
| 3. JB MODOS S.R.O. | SLOVAKIA | Banska Bystrica |
| 4. A.V.M. | FRANCE | Salon-de-Provence |
| 5. SOLCON GmbH | GERMANY | Wiesbaden-Igstadt |

Temporary sites :

- | | |
|----------------|-------------------------------------------------------------------|
| SWEDEN | Alvsbyn |
| GERMANY | Munich, Nürburgring |
| FRANCE | Avignon |
| ITALY | Rome, Nardo |
| FINLAND | Rovaniemi |
| SPAIN | Sierra Nevada-Granada, Calar Alto,
Madrid, Tenerife, Cartagena |

REVENUE consolidated :

2005	2,1	mio. €
2006	2,5	mio. €
2007	2,35	mio. €

PERSONNEL :

Fixed	30
Variable	50
Drivers / evaluators	
Mechanics	
Engineers	
Administration	
Management	

CLIENTS :

OEMs and suppliers. R&D departments, release & quality control

- **Toyota, BMW, GME-Powertrain, Opel, Daewoo, Daihatsu, Hyundai, KIA, KTM, Nissan, Yamaha, Mitsubishi**
- **Akebono, Aisin, BBA-Friction, Bosch, Brembo, Continental, Goodyear, Delphi, Hankook, Kumho, TRW, TMD-Friction, ZF-Lenksysteme.**

VALIDATION EXPERIENCE :

38 mio. km

1993 – 2008

23 mio. Km

SYSTEM VALIDATION

15 mio. Km

MODULE VALIDATION

TESTED BRAND PRODUCTS

MILEAGE [%]

Toyota / Lexus	41,8
Opel	23,4
Hyundai	7,9
BMW	7,7
KIA	6,8
VW	2,8
Mercedes-Benz	1,3
Nissan	1,2
Yamaha	0,8
Mitsubishi	0,7

Others :

5,6

Peugeot, FIAT, Ford, Renault, Volvo, Daewoo, Honda, Audi, KTM, Rover, Citroen

In Country: Spain

63%

Germany

15%

Sweden / Finland

7%

Slovakia

6%

France

5%

Italy

4%

Scope of Service

1. SYSTEM VALIDATION

“ Total Vehicle Validation in the Real World ”

DURABILITY

FUNCTION

QUALITY

RELIABILITY

- **Driving**
 - 100.000 / 200.000 km in Europe
 - method PISTE[®]
- **Evaluation of functionality**
- **Measurements**
 - tyre wear
 - brakes :
 - wear
 - noise
 - temperatures
 - alignment
 - fuel consumption
 - oil consumption
- **Engineering analysis**
 - reliability
 - functionality
 - wear
 - fatigue
 - endurance
 - economy
 - hand actions
 - functions
- **Reporting**
- **Consulting assessment**

2. MODULE VALIDATION

- **Brake test**
 - **Function & comfort/NV**
 - Mojacar
 - TOYOTA release criterium
 - benchmarking
 - permanent noise recording
 - **Mountain downhill & AMS**
 - temperatures
 - effectiveness / stopping distance
 - mountains in Spain, France, Alps
 - Spain highway, proving grounds
 - Hockenheim, Dudenhofen
- **Engine – long term**
 - **Function**
 - fuel system validation
 - consumption & emission
 - comparisons : injectors, fuel & oil types
 - **Special durability**
 - cold : Finland/Sweden/cooling chamber
 - hot : Spain/dessert

- **Transmission**
 - **Function** - clutch temperature
 - **Special durability** - high altitude : Calar Alto
- **Powertrain : longitudinal dynamics / propulsion**
 - acceleration time - AMS
 - maximum speed (race track)
 - speedometer accuracy
- **Dynamics & handling**
 - slalom
 - ISO lane change
 - proving ground / circuit
- **Exhaust system**
 - **Function** - catalyst temperature
 - **Special durability** - high altitude & high temperature
- **EOBD – long term**
 - high temperature : Spain, Marocco, Namibia
- **Steering system**
 - **Function** - including NV
 - **Special durability** - severe steering stress (mountain, bad roads)
- **Navigation system**
 - Europe
- **Tyres**
 - wear

3. OTHER SERVICES

- **Vehicle management for field survey (e.g. emission tests)**
 - vehicle location & recruitment
 - transportation
 - test organization
 - reporting
- **Chassis evaluation & tuning**
- **Nürburgring durability & tuning**
- **Press launch support**
 - vehicle evaluation, preparation & transportation
 - route research and definition
- **General testing support**
 - planning & logistics
 - driving & evaluation
 - instrumentation & measurements
 - engineering support : data analysis, reporting; evaluation & tuning
 - mechanical rebuilds of hardware components
- **Consulting**
- **Project management**

Why MODUS ?

MODUS METHOD

- small & flexible company

INTEGRATIVE SYSTEM using

MODUS-tool PISTE



- Real world
- Entire vehicle
- **HOLISTIC METHOD** ⇒ **COINCIDENCES**
- **REPRESENTING AVERAGE EUROPEAN CUSTOMER CONDITIONS**
- **NEUTRAL & OBJECTIVE**
- **RELIABLE**

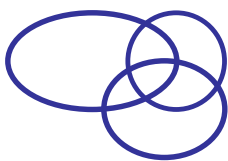
COMMON METHOD

- large size organization

SELECTIVE SYSTEM

- **Simulation**
- **Benches**
- **DETERMINED - components**
- **REPEATABLE**
- **Proving grounds**

Interaction / overlaps between integrated systems

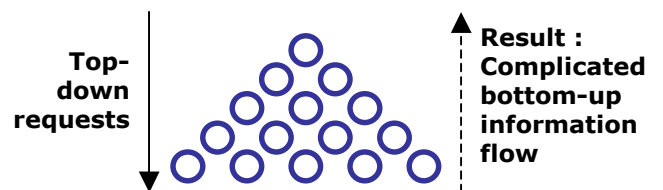


Easy & fast communication

MODUS : SPECIALIZED & EXPERIENCED

- 38 mio. km ⇒ test route knowledge
- 25 mio. km GPS ⇒ stress analysis
- Databases : tyre & brake wear, fuel & oil consumption
- All over Europe : habits & climate conditions

Isolated component tests



COST FACTOR

10 % of OEM revenue applies to field quality issues

Total Vehicle Validation Services Holistic Quality Monitoring in Reality

Management Summary

Computer simulation and test bench analysis does not cover all possible stress of the automobile's "real world".

The PISTE method with individual driving habits, climatic and topographic conditions like "CITY, MOUNTAINS, FREEWAY, WINTER and SUMMER" needs to be implemented.

The car's average life cycle of 160.000 km is compressed to a six months PISTE test phase.

Test run control by GPS, 100 % of driven test mileage logged for all vehicles – every second knowing what happens.

Validation in the real world is a mature method which reduces warranty cost and recall actions. The results are true, neutral, integrative and strong customer oriented.

Major Asian, American and European OEMs and Suppliers, e.g. Toyota, Mitsubishi, GM, Hyundai have proven the success of the MODUS PISTE method.

The MODUS test ground features the same dynamic parameters of kinematic and abrasion as routes like the "Stilfser Joch" and areas in Austria or Switzerland. MODUS guarantees a broad test of the entire vehicle as well as modules like "the Mojacar Brake Test", tyres, steering gear and embedded systems.

The OEM defines with the major tier-suppliers and MODUS a combined validation concept and the outline is based on a coherent business and benefits case.

In order to meet anticipatory customer satisfaction, the optimal time period for reality tests is the pre-series phase approximately 6 months before start of series production.

Benefits

- Costly quality repairs totalling 10% of OEMs' annual revenues resulting in a loss of quality image for reliability, customer satisfaction and confidence is the consequence.
- The integration of results stemming from an early warning system validation reflects a high benefit and more value - polishes a company image and increases customer satisfaction.
- Benchmark testing shows the difference of quality to competitive models.
- Supplier integration during the validation process leads to higher quality at a pre-series stage.

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