Incubator of tomorrow Technologies_

BE READY
for the
future_

EXOÈS ENGINEERING

- Improves powertrains
- Reduces emissions

OUR SKILLS

- Thermal management
- Fluid transfers

FROM CONCEPT TO PRODUCTION

SCOPE and USPs_

SIMULATION

PRODUCTION

SYSTEM DESIGN

VEHICLE INTEGRATION

PROTOTYPES

TEST RIGS

OUR USPs

- Customer centric
- Risk management oriented
- Development time shortened

REFERENCES_


bosal


DANA


faurecia


MAN


MODINE


PSA PEUGEOT CITROËN


SWEP


TENNECO


Valeo


VOLVO

A highly seasoned **TEAM_**

Our experts has a thorough experience in the **automotive and compressor** industry and come from the following companies:

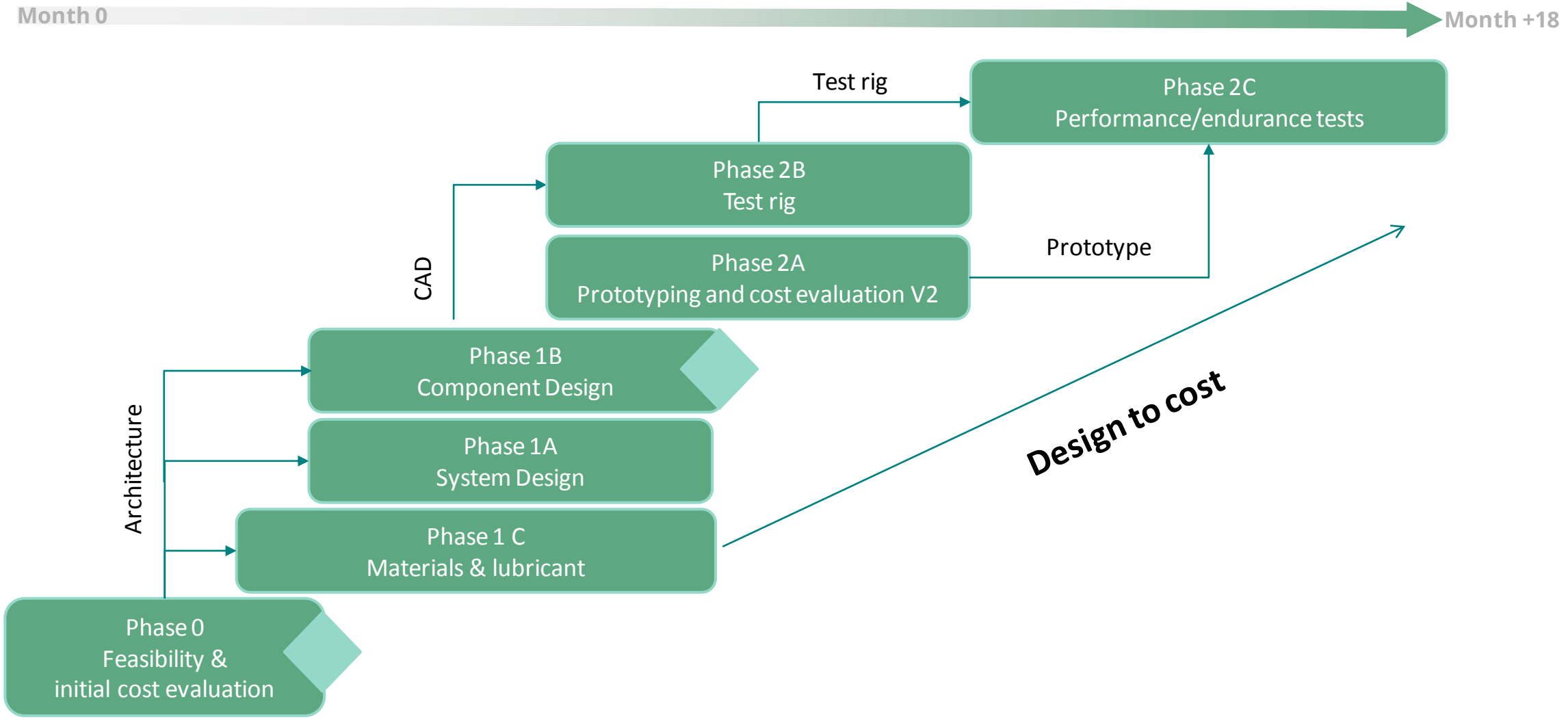
Eberspächer · faurecia · Danfoss · Tecumseh · PSA PEUGEOT CITROËN · BOSCH

A solid experience in **product and system development acquired** in ORCs for trucks since 2009:

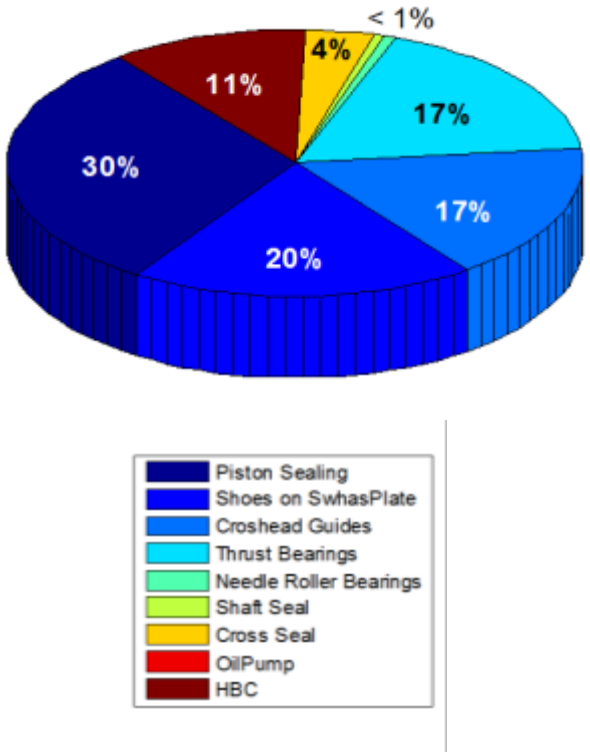
- Piston best-in-class expander developed from concept to B sample – 10 patents
- Solid system experience – more than 10 complete ORC systems developed for 7 customers
- Joined vehicle integration workshop with major OEMs and tier ones

SYSTEM ENGINEERING & product development_

EXOÈS PROCESS from concept to A samples



Simulation_

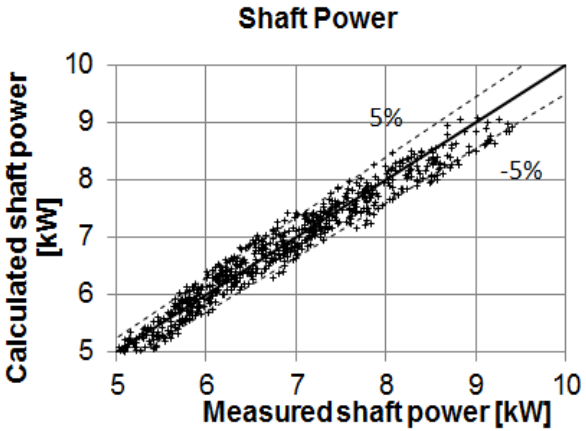


Friction losses repartition

SIMULATION SKILLS

- Refprop database for fluids
- Exergy and energy balance analysis
- CFD
- FEA
- Test data post processing

Simulation_



EXAMPLE OF OUR OWN MATLAB MODELS

- Swashplate Piston expander: calibrated – 1D
- Scroll expander: calibrated – 1D
- Crankshaft piston expander – 1D
- Piston pumps – 0D
- Gear pumps – 0D
- ORC cycle – 0D
- Evaporator – 1D – dynamics

COMPONENT
design &
prototyping_

DESIGN SKILLS

- Functional analysis
- FMEA
- Value analysis
- Cost evaluation
- Sourcing - more than 200 suppliers

COMPONENT
design &
prototyping_

EXAMPLE OF PROTOTYPES REALIZED FROM SCRATCH :

- Single cylinder expander
- Swashplate piston expander
- Valvetrain design
- Piston pump
- Internal gear pump
- External gear pump
- Scroll expander
- Tube-in-shell evaporator
- Tube-in-tube evaporator

MATERIAL
& lubricant_

- Fluid design
- Tribology & wear in extreme conditions
- Fluid ageing
- Material compatibility
- Cost evaluation

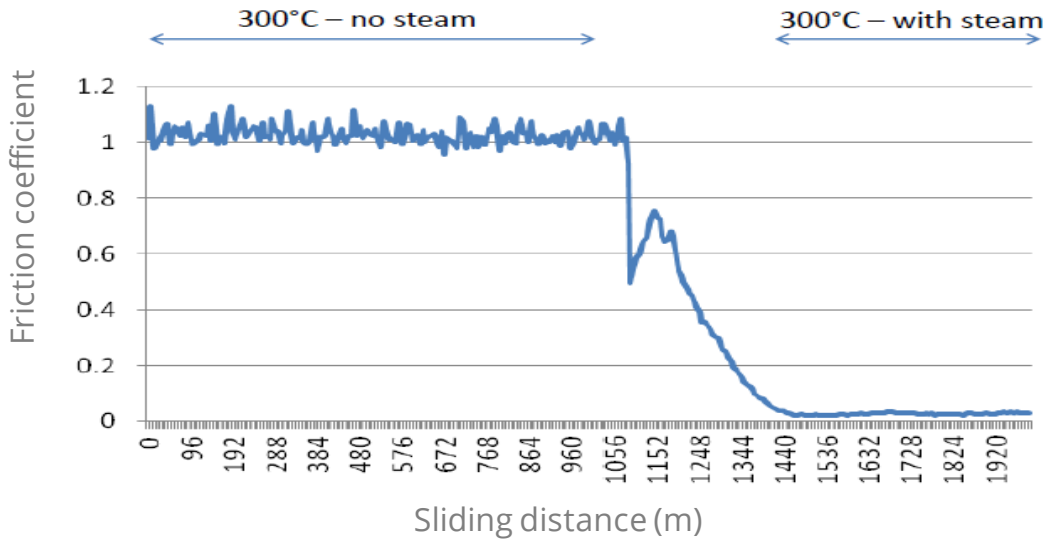
Tribometer

Miscibility/solubility measurement vessels

Test facilities at Exoès:

- Corrosion tests in 3 autoclaves
- Compatibility tests for polymers and elastomers
- Thermal stability

Tribology_



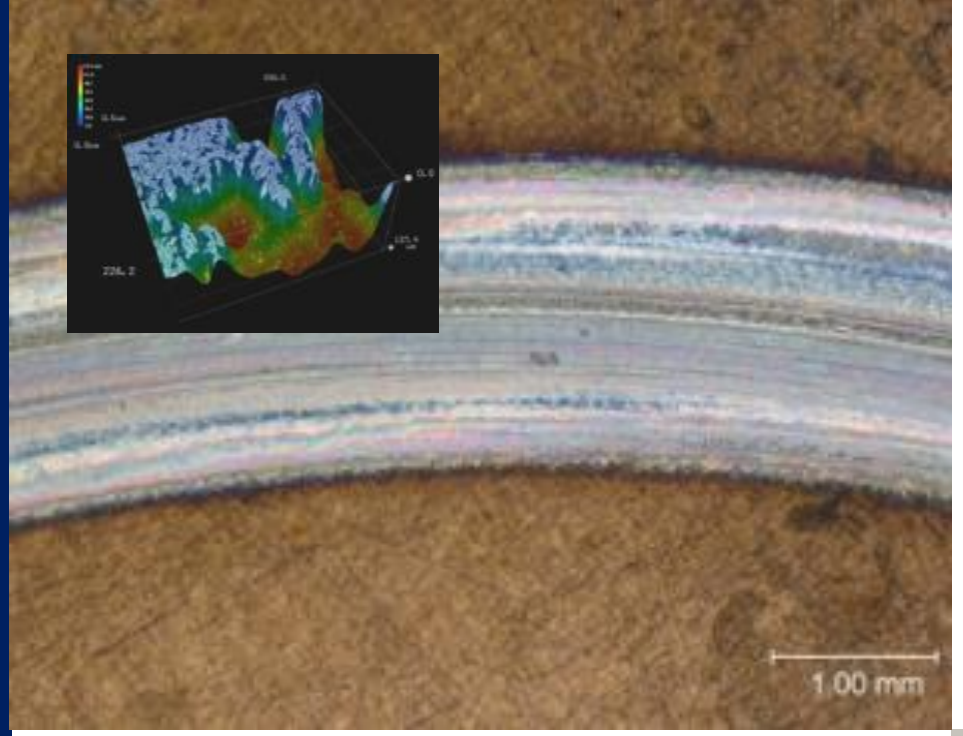
PROBLEM SOLVING PROCESS

- Screening the state-of-the art resulting to a first material selection.
- Experimental determination of the most promising material couples.
- Wear rate assessment done on tribometers and organ test rigs.
- Failure analysis, Surface morphology: LOM, SEM, EDS, XPS, Raman, Stability of protective coatings

EXAMPLES ON FORMER PROJECTS

- Oil-free carbon ring : achieved wear rate in 180°C water vapor: $5.10^{-8}mm^3/N.m$
- Oil-free carbon ring : achieved friction coefficient in 180°C ethanol vapor: 0.05
- 5,270 hours of autoclaves test to populate a database of material compatibility in ethanol vapor

Tribology_



← Worn surface morphology

Vapor tribometers →

Tribologist NET_

EXPERTS

Dr. Mathias Woydt
Tribology
BAM – Germany

Dr. Jean-Louis Ligier
Mechanics
Comatec -Switzerland

PARTNERS

BAM

placamat

LISMMA

COMATEC

le cnam

icmcb
institut de chimie de la matière condensée de bordeaux

CESAMO TECH

SYSTEMS CONTROL and tests_

CONTROL DEVELOPMENT

- LabVIEW Real-Time
- Failsafe PLC – EN ISO 13849

TESTS

- Tests in lab
- Tests on engine test cell
- Tests on roller test rigs

TURNKEY complete systems delivered

Rig type	Power	Fluid	Customers
WHR ORC coupled to an ICE (2L gasoline engine)	3 kWe	Ethanol	Valeo
Complete dynamic ORC system bench	15 kWe / 150 kWth	Ethanol	DANA bosal
Heat exchanger (ORC evaporator) test rig	150 kWth	Ethanol	TENNECO
Biomass CHP	3 Kwe	Water	ÖkoFEN
ORC test bench	3kWe	R245fa	ULg Université de Liège
Solar ORC test rig – stand alone	12 kWe	R245fa	Schneider Electric

From design **TO** final product_

TEST CAPACITIES at Exoès lab_

DYNAMIC TEST RIGS FOR POWERTRAIN AUXILIAIRIES

Flammable fluids accepted

Possibility to run dynamic drive cycles

Gaz burner	200 kW	200g/s	600°C
Electric brake	50 kW	5.500 RPM	
Transient	5.000 RPM/s	350°C/s	200g/s^2

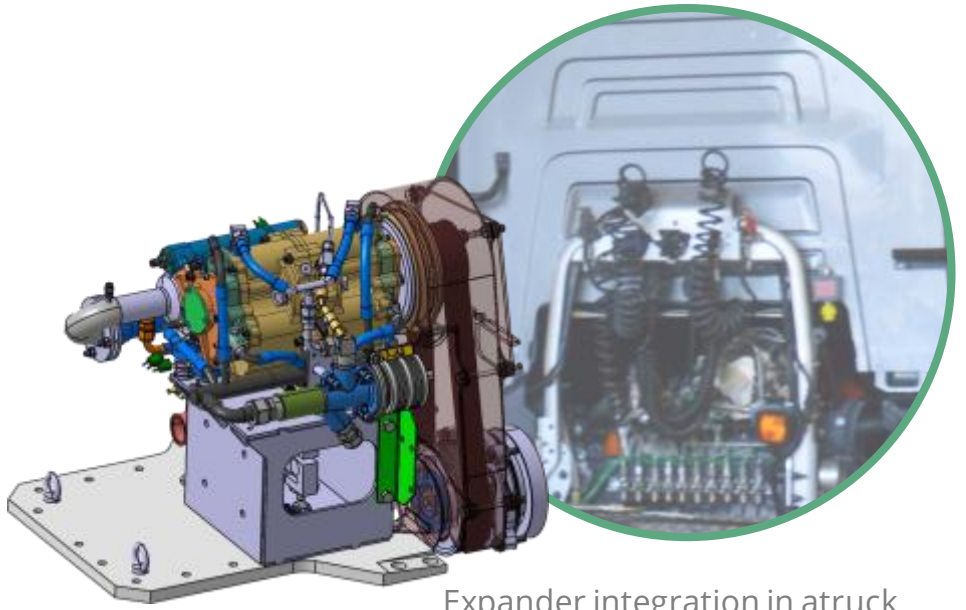
ENDURANCE TEST RIGS FOR COMPONENTS

	Automatic	24/7	
Heater	Heating oil	200 kW	300°C
Electric brake	25 kW	6.000 RPM	

Vehicle integration workshops **TOGETHER WITH CUSTOMERS_**

SYSTEM INTEGRATION IN A VEHICLE

- CAD
- FEA and vibrations
- Prototyping
- Assembly
- Test analysis



Expander integration in atruck

A SOLID SCIENTIFIC BACKGROUND, with an international influence_

— Rémi DACCORD,
Exoès CTO speaker at ATZ, Germany

SCIENTIFIC publications_

Download our scientific publications on our Website

2016 – ETA
Berlin GERMANY
Rankine cycles, industrialisation challenges

2016 – FISITA
Busan SOUTHERN KOREA
Presentation of a waste heat recovery solution for HGV

2016 – Paper published in Applied Energy
Article
BOUVIER JL, KIENTZ & Al. "Experimental study of an oil-free steam piston expander for micro-combined heat and power systems", Applied Energy 169, 2016, pages 788-798

2016 – EORCC
Belfast NORTHERN IRELAND
Presentation of truck integration issues with EVE®, piston expander and exhaust waste recovery solution

2015 – AORCC
Detroit USA
Presentation of a waste heat recovery solution for HGV

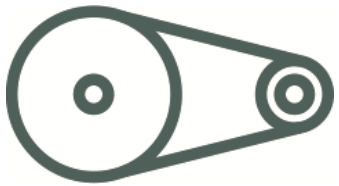
2014 – SAE
Detroit USA
Presentation of a waste heat recovery solution for cars

2013 – ATZ
Ludwigsburg GERMANY
Presentation of a waste heat recovery solution for HGV

2013 – ASME-ORC
Rotterdam NETHERLANDS
Presentation of a waste heat recovery solution for cars

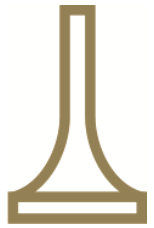
EXOÈS, your partner for...

COMPONENTS



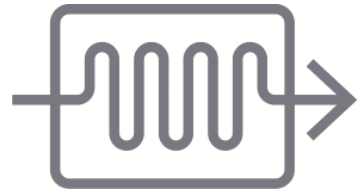
Compressors

Pumps



Valves

Expanders



Heat exchangers

SYSTEMS

Heat pumps

Climate control systems

ORC systems

Fuel cell