



# Electric Powertrain Health Monitoring for Increased Safety of FEVs

Duration: 1/06/2012-30/11/2014

Budget: ~3M€ (2M€ funded by EC)

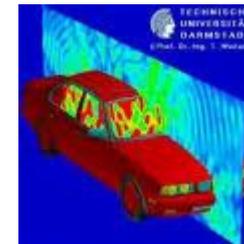
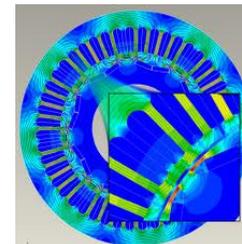
Ainhoa Galarza



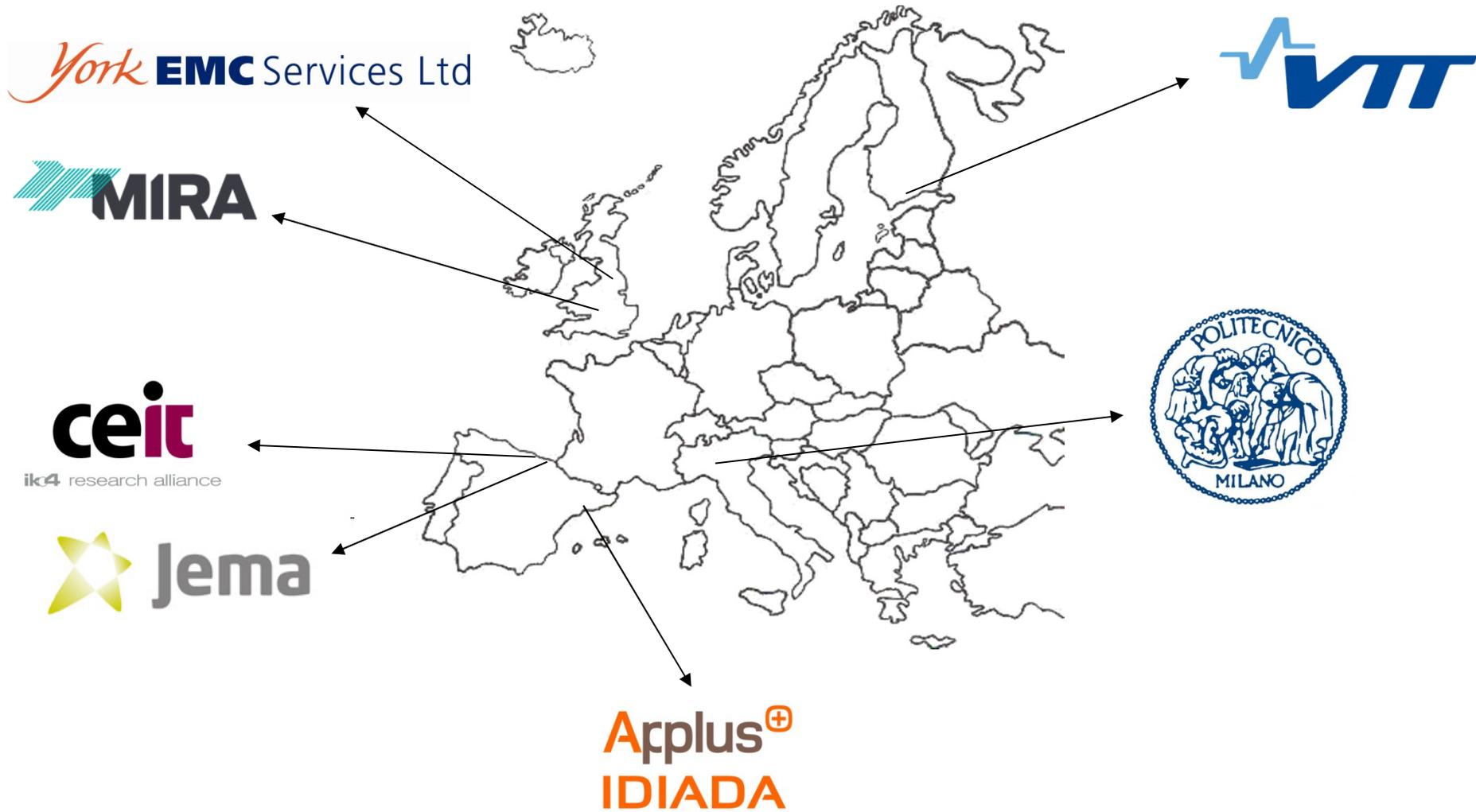
# Introduction

## HEMIS project

- Development of a Prognostic Health Monitoring System (PHMS) for the failsafe transition of FEV powertrain
- Assessment of the impact of electric powertrain on human health and EMC issues



# Introduction



EGCI Clustering event, Brussels, 11-12th July 2012



# Project main objectives (I)

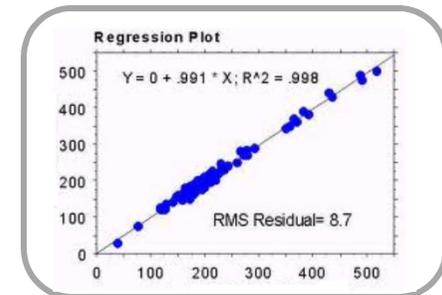
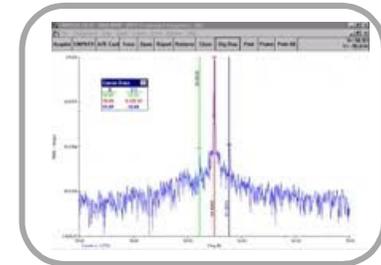
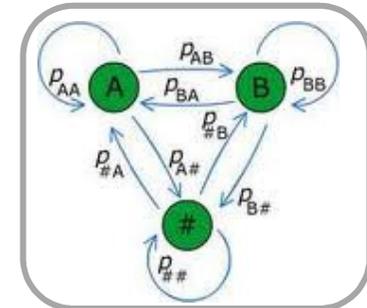


- To develop a Prognostic Health Monitoring System (PHMS), which:
  - Provides information on the failsafe state of the electric powertrain
  - Enables to apply a condition-based maintenance policy on its subsystems by predicting their Remaining Useful Life (RUL)
- Increase safety and maintainability of FEVs
- Reduce the cost of FEVs due to acquired knowledge of failure mechanisms

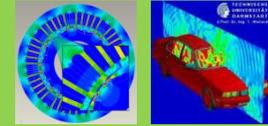
# S&T Challenges & Technological approach (I)



- Define a generic architecture for the FEV
- Undertake an RAMS analysis and define RAMS requirements for the powertrain and the PHMS
- Improve knowledge of failure mechanism
- Identify which physical variables are the best to monitor regarding: reliability, accuracy, cost, and their integration into FEVs
- Integrate hybrid data and information into a prognostic algorithm to estimate an RUL value.

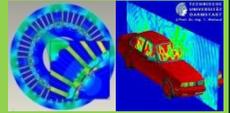


# Project main objectives (II)



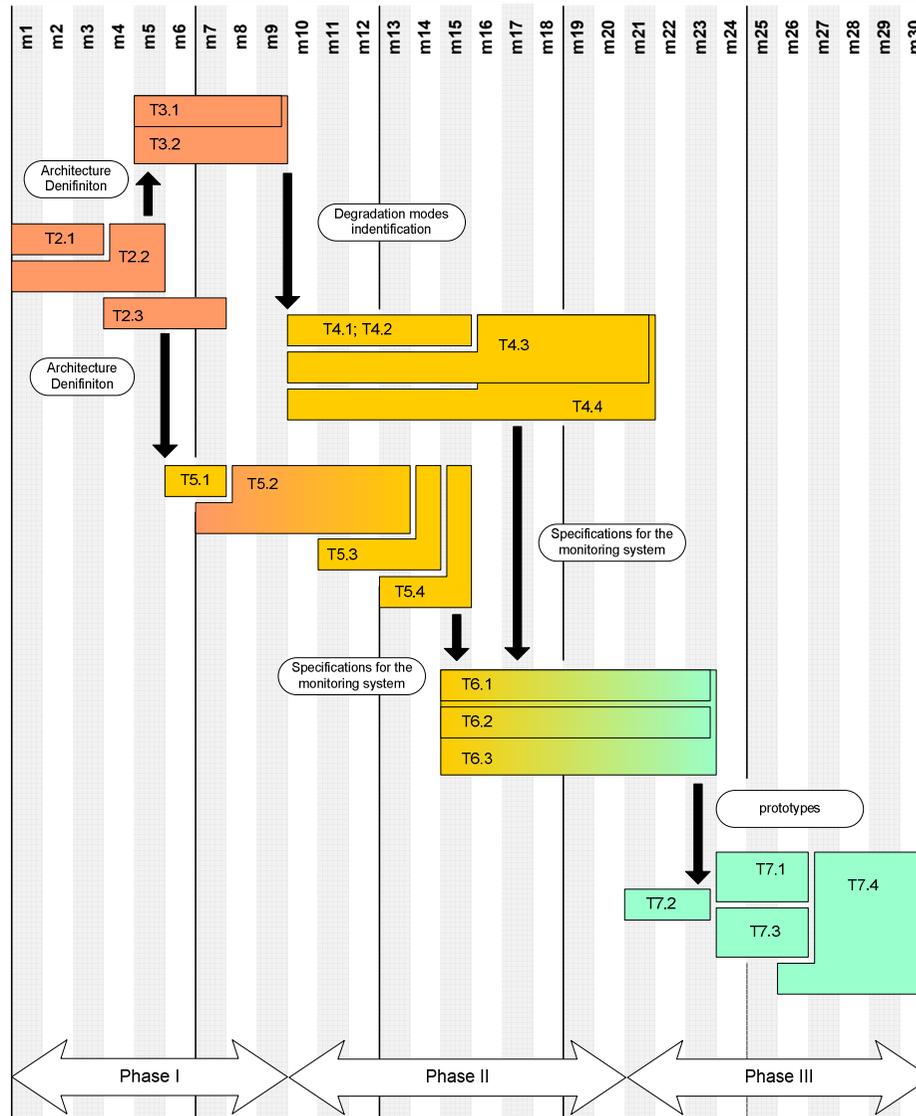
- Assess the impact on human health of EMFs:
  - Electric traction motors
  - High switching frequency power electronics
- Propose reference levels for in-vehicle human exposure EMF
- Contribute to standard bodies
- Provide manufacturers of FEVs with:
  - Design guidelines regarding EMC and impact of EMF on human health
  - Low frequency emissions testing methods
- Enhance public confidence in FEVs

# S&T Challenges & Technological approach (II)



- Identify the limitations of current legislative requirements regarding EMF
- Study the relationship between non-uniform low frequency emissions and current density induced in the occupants by means of complex biological models
- Measure EMF generated by the powertrain
- Propose in-vehicle reference levels
- Define EMC testing methods
- Integrate EMF measurements in the PHMS

# Project timing



T2.1 Preliminary Hazard Analysis of the FEV  
 T2.2 Architecture definition and RAMS model  
 T2.3 RAMS apportionment of the FEV



T3.1 Definition of the causes of degradation of the motor and their consequences  
 T3.2 Definition of the causes of degradation of the control and their consequences



T4.1 Identification and assessment of the physical characteristics to monitor the performance of the motor  
 T4.2 Identification and assessment of the physical characteristics to monitor the performance of the control  
 T4.3 Prediction of the Remaining Useful Time of the FEV motor subsystem  
 T4.4 Prediction of the Remaining Useful Time of the FEV control subsystem



T5.1 Identification of gaps in current EMC and EMF testing for FEVs  
 T5.2 Analysis and simulation of EMF and their consequences  
 T5.3 Definition of EMC measurement and testing methods for FEVs  
 T5.4 Establishment of the limits for the EM pulses and identification of mitigation techniques



T6.1 Identification of the hazard limits and design  
 T6.2 Implementation and testing of the on-board monitoring system for the control  
 T6.3 Establishment of the human exposure health level of EMFs and design of the on-board monitoring system for the EM emissions



T7.1 Integration of the on-board monitoring system for the RAMS requirements of the FEV  
 T7.2 Definition of the test setup for the verification process of the monitoring system for the RAMS requirements of the FEV  
 T7.3 Implementation of the test setup for the verification process of the monitoring system for the RAMS requirements of the FEV  
 T7.4 Verification of the on-board monitoring system for the RAMS requirements of the FEV



# Potential outcomes

- PHMS and on-board sensors
- Tools for the evaluation of FEVs
- Tools for the simulation of electromagnetic fields
- Consultancy and Training on FEV's electronics design and vehicle certification
- Competitiveness increase for FEV manufacturers and suppliers

# Cooperation within the cluster

- Reference architecture(s) for FEVs
- Powertrain failure mechanisms and on-board monitoring
- EMFs and their effect on human health

# Contact

## Thank you

[www.hemis-eu.org](http://www.hemis-eu.org)

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