



HAL
open science

Eco-Design & Circular Economy of Heavy-Duty & Off-Road (HDOR) Vehicles

Michael Saidani, Bernard Yannou, Yann Leroy, François Cluzel

► **To cite this version:**

Michael Saidani, Bernard Yannou, Yann Leroy, François Cluzel. Eco-Design & Circular Economy of Heavy-Duty & Off-Road (HDOR) Vehicles. CRIEC 2016, Jun 2016, Chatenay-Malabry, France. hal-01340766

HAL Id: hal-01340766

<https://hal.science/hal-01340766>

Submitted on 1 Jul 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Contextual Framework

HDOR Features & Issues

- **Mass of EoL HDOR = Mass of ELV** in France [ADEME 06]
- **Poor traceability** after sales & **Recycling channels** are **marginal**
- **Shipment of HDOR** by **illegal operators** is still a flourishing business [EC & Bio by Deloitte 14]

Emerging Technologies

- **Intelligent** Transportation System
- More & more **devices connected** to the OBD (On Board Diagnosis)
- GPS + RFID + **IoT** + **Telematics** + **Big Data Analytics** applied to transportation and construction industries

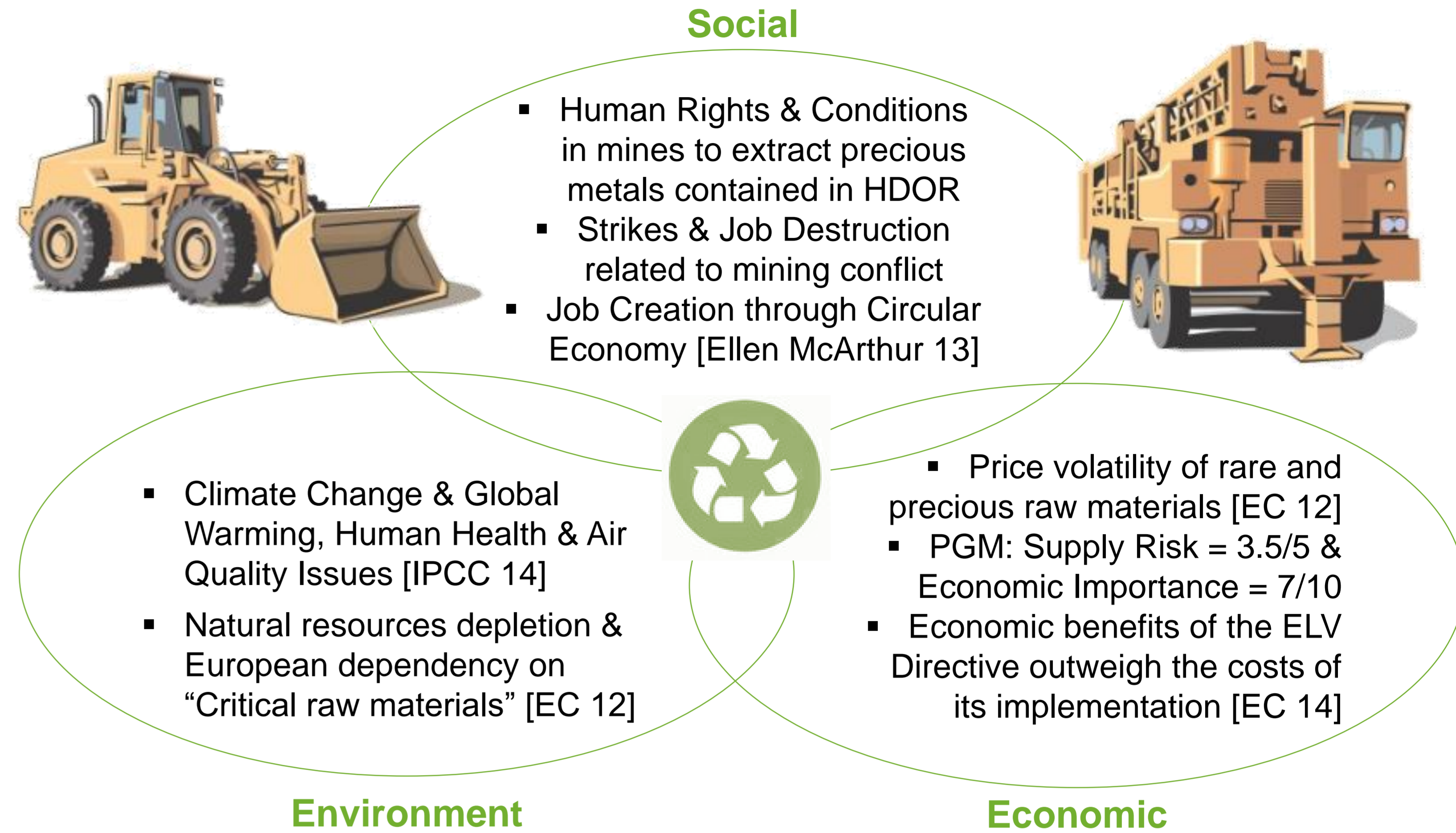
Regulations

- **Absence** of a regulatory framework for EoL & CO₂ emissions of HDOR, contrary to ELV (2000/53/EC)
- Extended Producer Responsibility for some spare parts
- Beware: **Geographical disparity** of EoL & Emissions Regulations
- REACH; WEEE; RoHS

Industrial Needs

- **Anticipate upcoming regulations**
- Develop **new Business Model** (e.g. PSS, Telematics Offers)
- **Eco-management** in **real-time** (e.g. eco-drive, preventive maintenance)
- **Reduce dependency** on oils & precious raw materials
- **Waste Management & Treatment**

HDOR Vehicles & Sustainability Issues

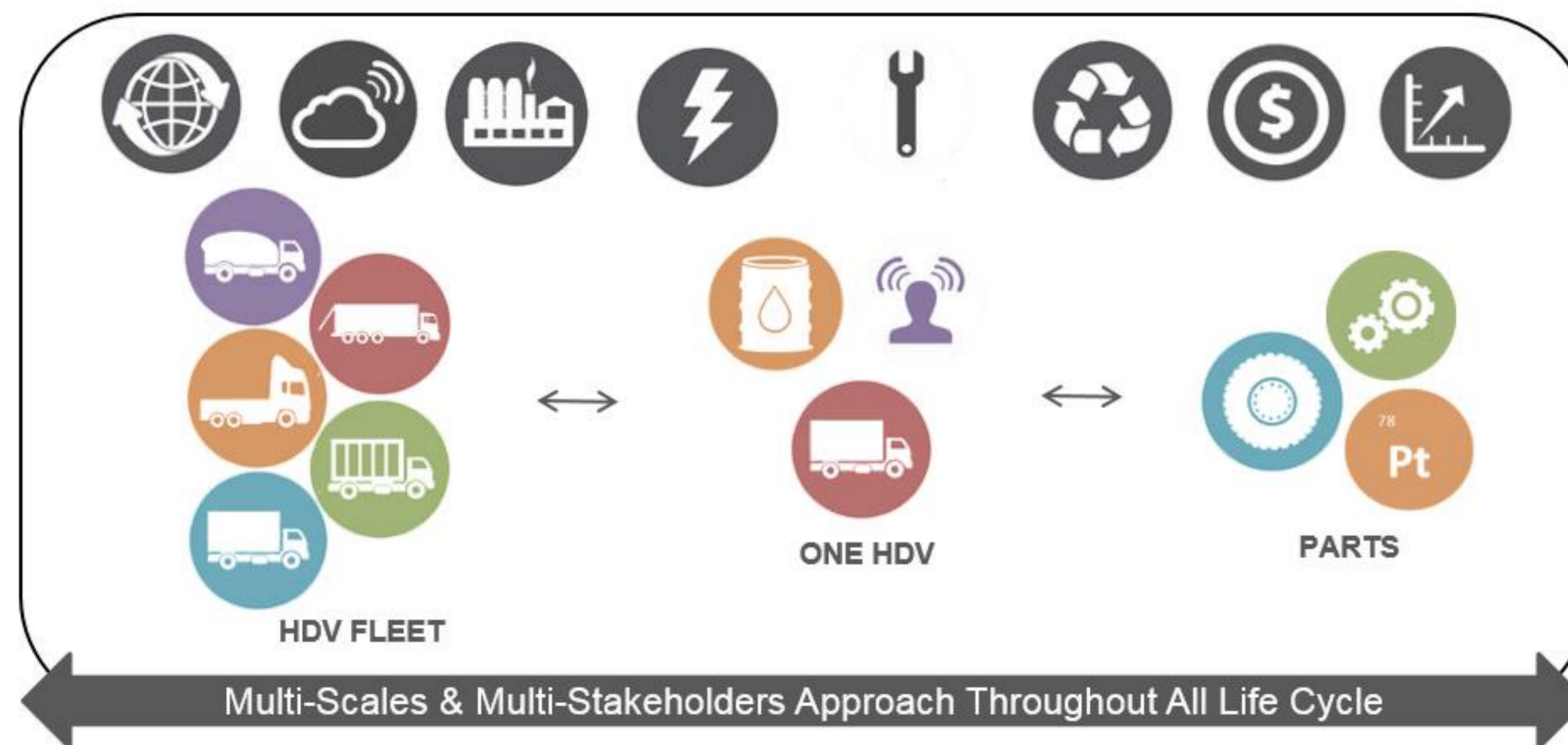


Research Question & Objectives

Research Question

- How to **optimize** the **sustainable management** of a **fleet of HDOR** throughout **all life cycle**, at **different scales** and for **all stakeholders** thanks to the help of the **new and emerging technologies, IoT & Telematic Systems**?

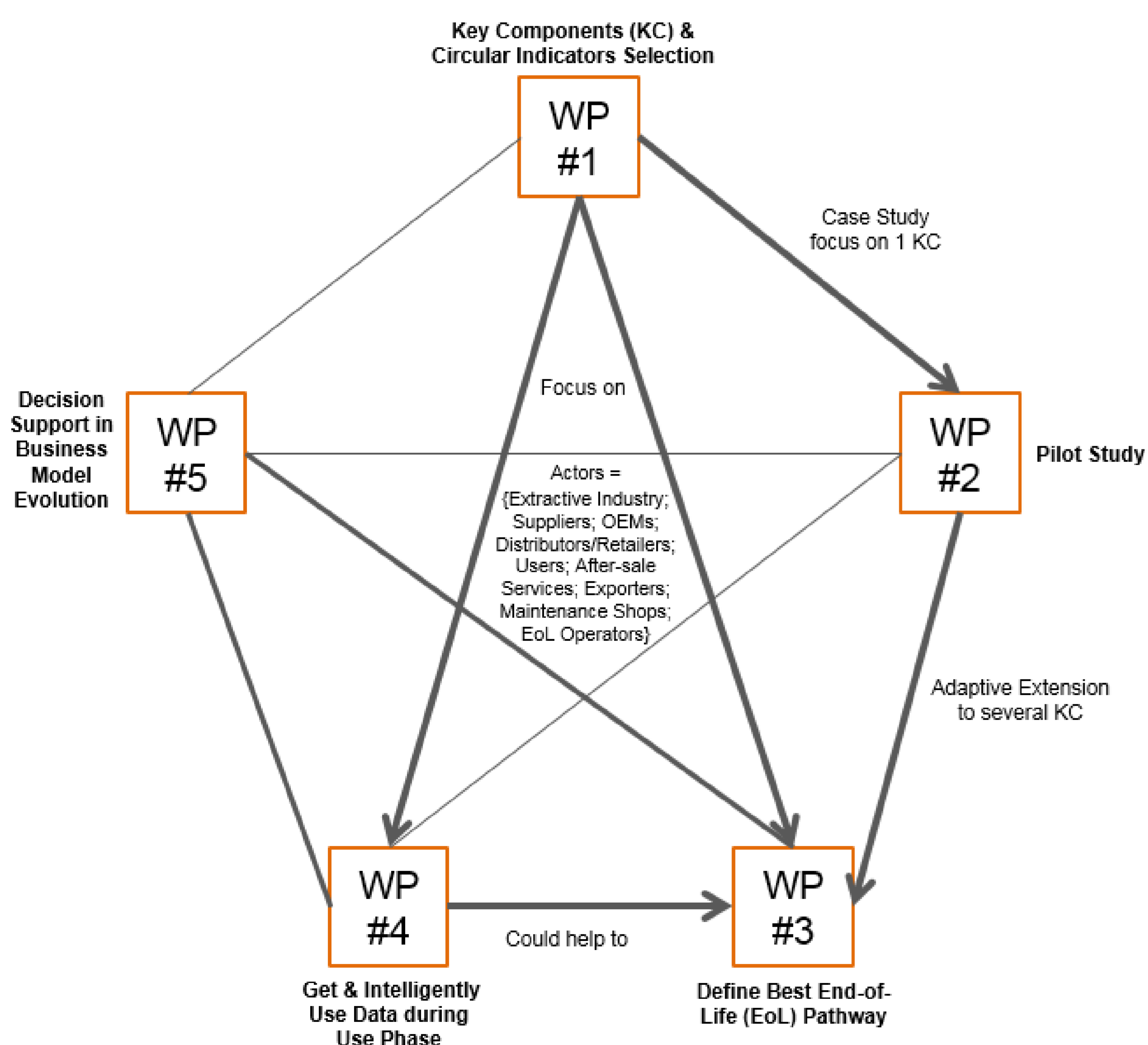
→ **Significant issue** divided into five **linked & complementary WorkPackages (WP)**



Objectives

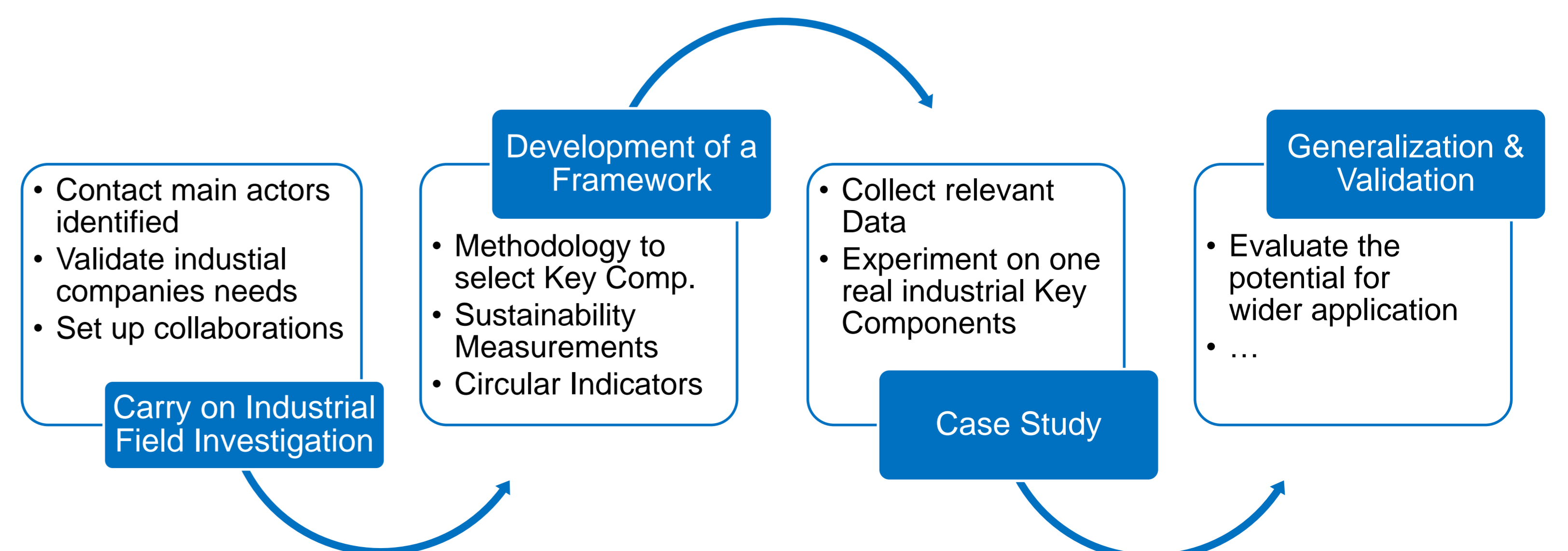
- For **Academics** = To develop relevant frameworks to handle the 3 sustainability pillars within socio-technical complex systems
- For **Industrials** = To foster and help companies to a sustainable management of their HDOR fleet all along the life cycle
- For **Policy-Makers** = To support strategic policy decisions concerning the EoL of HDOR

Problem-Solving Method



Progress, Perspectives & Next Steps

- ✓ **Extensive Literature Review**
- ✓ **Key words** = {Circular Economy; Design for 3R; End-of-Life Options; End-of-Life Vehicles; Modular Product Design; Sustainable Business Model; Sustainable System Design; Telematics & IoT Applications for HDOR; Upgradability; Usage Modeling in Design; Usage Predictive Model; Value Chain Design}
- ✓ **Main References** = [Farel & Yannou 13] [Kim et al. 16] [Ma & Kremer 15, 16]
- ✓ **Gaps Identified:**
 - Lack of tools to monitor overall performance of the circular economy;
 - A need to aggregate as many sustainability themes as possible into a framework, and from a dynamic point of view;
 - How to include user-generated contents, and organize consumption and maintenance feedbacks, in real-time and also during design process.
- ✓ **Meetings with experts from ADEME**, french environmental agency
- ✓ Establishment of a **Contact List**, with potential industrial companies to collaborate
- ✓ **WP#1 Progress** = Great range of criteria to select Key Components
- ✓ **WP#3 Progress** = Identification & Definition of 10 End-of-Life Options
- ✓ **WP#4 Progress** = Mapping of Information that could be captured in Heavy Vehicles



References

- [EC 12] Report on Critical Raw Materials for the EU, European Commission, 2012.
- [EC 14] Ex-post evaluation of certain waste stream Directives, European Commission, 2014.
- [Farel & Yannou 13] Farel R., Yannou B., A Method to Design a Value Chain from Scratch, ICoRD' 13, Lecture Notes in Mechanical Engineering, India, 2013.
- [Ellen McArthur 13] McArthur, E., Towards the circular economy, Journal of Industrial Ecology.
- [IPCC 14] Climate Change 2014: Synthesis Report, IPCC, 2014.
- [Kim et al. 16] Kim H., et al., Research Perspectives in Sustainable Design, Design Science.
- [Ma & Kremer 15] Ma J., Kremer G., A sustainable modular product design approach with key components and uncertain EoL strategy consideration, Journal of Cleaner Production, 2015.