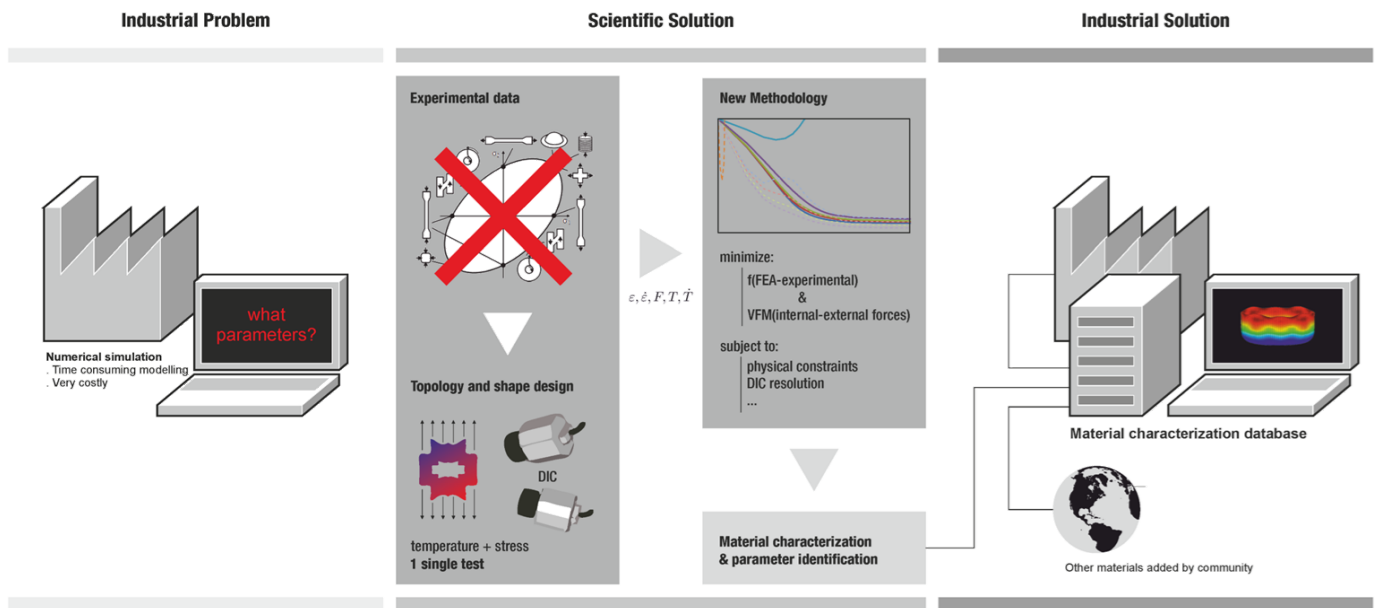


## Project

# NEWSLETTER



**Toward virtual forming and design: Thermomechanical characterization of high strength steels through full-field measurements and a single designed test**

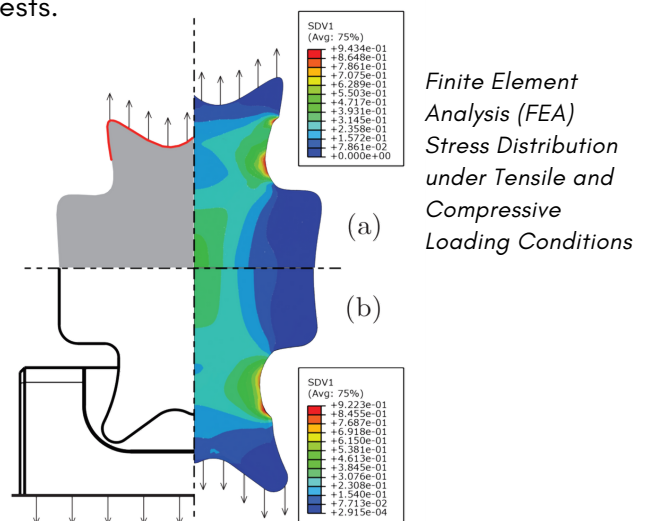


## Context

Recently, numerical simulations, especially finite element analysis (FEA), have become essential in optimizing material processing. The TechNavio report titled "Global Simulation and Analysis Software Market" from 2016 highlights that FEA accounts for about half of the simulation market, with its use in the automotive sector surpassing \$928 million by 2019. Despite the widespread application of FEA in engineering design and the significant market size, the challenge of obtaining accurate FEA input data remains, particularly in describing the non-linear behavior of materials. This issue persists in the FEA software industry, necessitating solutions for both users and providers.

Therefore, the characterization of materials has received increasing attention due to the need for precise input data to computational analysis software at a lower cost.

Simulation software uses complex material constitutive models and the successful prediction of the real thermo-mechanical and ductile failure behaviour is inherently dependent on the quality of the model and the related material parameters. In general, these parameters are determined using multiple and different standard tests.



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## Our Goals

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The main goal of this project is to develop an efficient and accurate methodology for determining the material parameters of advanced thermo-mechanical and ductile damage models from a dedicated single test that involves non-homogeneous temperature and strain fields.

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### What's expected to obtain?

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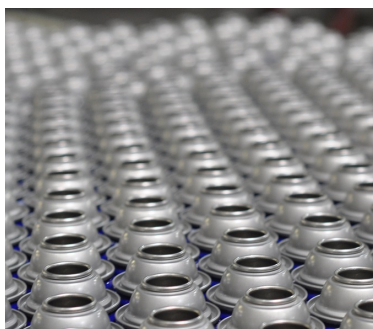
- (I) A numerical methodology and its computational tool able to efficiently and automatically represent the thermo-mechanical and ductile damage behaviour of advanced high strength steels, through complex material constitutive equations and optimization of the large number of parameters;
- (II) A suitable temperature and strain heterogeneous mechanical test, able to provide the largest number of strain states and present complex thermal-strain fields such as the ones occurring in warm-metal-forming operations;
- (III) A database of material constitutive equations and parameters calibrated to a large number of AHSS.

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### The challenge

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The homogeneous thermal, stress and strain fields generated in these relatively simple tests do not fully represent the complex heterogeneous thermal, stress and strain fields occurring in warm metal forming operations. Additionally, inverse methodologies commonly used, e.g. minimization of experimental vs FE model, are not reliable enough, due to the non-uniqueness of the solution. Furthermore, for complex constitutive models with many parameters, a high number of classical standard tests must be included in the experimental database, leading to an expensive and time-consuming experimental characterization and identification process.



#### Consortium members



universidade  
de aveiro

*University of Aveiro (UAVR)*

The University of Aveiro (UAVR) in Portugal is known for its dynamism and innovation, with approximately 14,000 students across 16 departments and 4 polytechnic schools that adopt an interdisciplinary approach.

During 2016, 282 research and technology transfer projects were active in UAVR. Ninety-five of these projects are/were funded by International and European Programmes, of which 20 by the 7th Framework Programme, 25 by the Horizon 2020 and 21 by the ERASMUS+.

The Centre for Mechanical Engineering and Automation (TEMA) at UAVR aligns with the university's strategy, aiming for scientific and technological excellence in mechanical engineering and materials research, with a focus on meeting the needs of Portuguese society and industries.



*University of South Brittany (UBS)*

The University of South Brittany (UBS) is a multidisciplinary institution located across two main campuses in South Brittany, France. It offers a range of academic programs from bachelor's degrees to doctorates to its 8,500 students, who represent 72 nationalities.

UBS's research is conducted by 250 researchers and 240 PhD students across 13 laboratories in four specialties: law-economics-management, languages and social sciences, mathematics-information and communications sciences, and materials-marine biochemistry and coastal studies.

**KU LEUVEN**

*KU Leuven (KUL)*

KU Leuven, founded in 1425, ranks among the best universities in Europe when it comes to research and has been named the most innovative university of Europe for 3 years in a row now by Reuters.

KU Leuven Research & Development (LRD), established in 1972, was one of the first tech transfer offices in Europe, and has helped the university spin off more than 100 companies across a range of industries and generate an average of 100 patent applications per year.

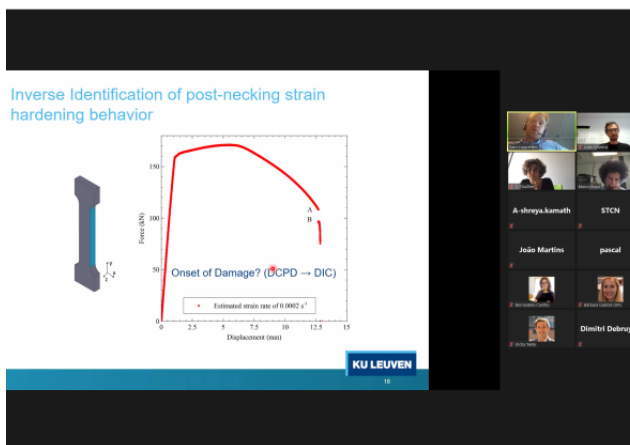
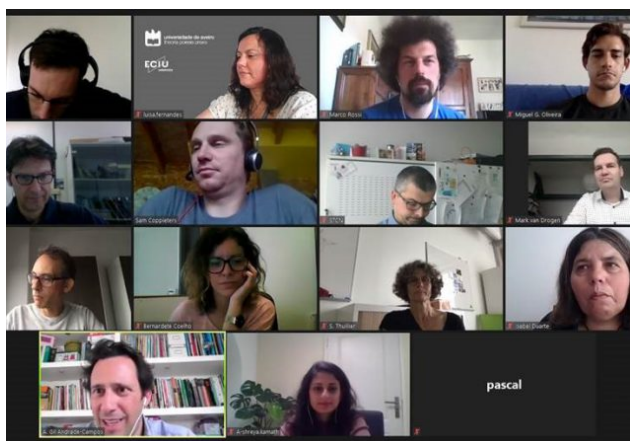
KU Leuven offers education in all main areas to over 50,000 students.

## News

### Two successful kickoff meetings

The project has started with a reception meeting at the 9th July and a longer and fruitful meeting at the 3rd September.

All partners were represented in both meetings.



### Do you want to know more?

You can find more information on the official website of the project: <http://www.vform-xsteels.eu/>

If you want to know the consortium better, visit the webpage of our partners by clicking on their logotype.

#### This project has received funding from:

The Research Fund for Coal and Steel under grant agreement No 888153



UNIVERSITÀ  
POLITECNICA  
DELLE MARCHE

Università Politecnica delle  
Marche (UNIVPM)

Università Politecnica delle Marche (UNIVPM) is a Public University located in Ancona, in the region of central Italy named Marche, from which it takes its name. UNIVPM offers undergraduate and graduate degrees in Engineering, Economics, Medicine, Biology and Agriculture. It has around 16 000 students and more than 7000 of them are attending the Faculty of Engineering.

The Department of Industrial Engineering and Mathematics (DIISM) is very active in collaborations with companies, universities and research centres, and has a solid experience in European project participation and management. In the last 5 year the department participated to more than 400 industrial and research project and to 18 European projects.

## MatchID

MatchID (MID)

MatchID Metrology Beyond Colors, N.V. (hereafter referred to as MatchID), a new spin-off company of KU Leuven, offers solutions in strain measurement, model validation and automated identification of mechanical material properties.

Although MatchID was only recently founded in 2014, it could quickly establish a relatively broad and solid customer basis, both in academia (> 60 systems) and industry (>20 systems)

Their customer basis encompasses the US, Europe and China, giving the company a true international character and involves prestigious customers as Exxon Mobil, Sandia National Laboratories, Huntsman, DSM, Dow Chemical, Solvay etc



Onderzoekscentrum voor  
Aanwending van Staal nv (OCAS)

OCAS is a research center specializing in advanced steel and metal products, offering services and solutions globally to metal processing industries. It's a subsidiary of FINOCAS and ArcelorMittal Belgium, with FINOCAS itself being a joint venture between the Flemish Region and ArcelorMittal Belgium. Within the ArcelorMittal group, OCAS operates as ArcelorMittal Global R&D Gent, responsible for all R&D projects in the general industry market for flat carbon steel.

OCAS is equipped with state-of-the-art R&D tools and facilities in its laboratories in Zelzate and Gent-Zwijnaarde (Belgium) and also has a highly qualified team of over 140 researchers and engineers with an international orientation.

## DAF

DAF TRUCKS NV (DAF)

DAF Trucks (Netherlands) is a leading manufacturer of light, medium and heavy-duty commercial vehicles. As a PACCAR company, DAF Trucks is a leader in applying state-of-the-art technology.

For the chassis parts (thick materials) DAF do the forming operations in house (bending etc.) guided by simulations.

As far as simulations are considered, DAF depends on external partners who do modelling/simulation related work on the cabins in terms of material, crash and fatigue performance. Therefore, DAF is an end user of steel and simulation.