ENVIHEI

Title of the PBL challenge: **Gravel Bike Analysis Project Incorporating Sustainability Concepts**

Name of the responsible lecturer

Gabriel Medina Martínez

University / Department / Degree program

University of León / Mechanical, Computer and Aerospace Engineering / Bachelor's Degree in Mechanical Engineering

Course / Subject in which implemented

4th Course / Project Management

Implementation period (dates)

September 8, 2025 – December 19, 2025

Total duration (weeks/hours)

14 weeks / 42 hours

Number of students involved

38 students (36 from Mechanical Engineering + 2 from Aerospace Engineering)

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1. Project Design

1.1 Brief description of the project and the challenge proposed

This Project-Based Learning (PBL) experience is implemented in the Project Management course at the University of León, in the 4th year of the Bachelor's Degree in Mechanical Engineering, with additional participation from 4th-year students of the Bachelor's Degree in Aerospace Engineering. The experience is part of ENVIHEI, an Erasmus+ project coordinated by the University of León and aimed at promoting environmental sustainability in higher education through innovative, student-centered methodologies.

The challenge consists of analysing a real gravel bike, the New Simun model by MMR, according to environmental sustainability and circular economy criteria. The objective is to identify improvements that could reduce the environmental impact of the product while maintaining an activity linked to real-world professional project management situations.

The challenge is developed with the participation of lecturers from the Engineering Projects Area, a panel of experts associated with MMR Bikes, and engineering students. MMR provides technical documentation on the bicycle and its manufacturing process, sector-specific context, and an industrial perspective on current sustainability concerns in the bicycle industry.

1.2 Expected learning outcomes (academic and transversal competences)

Through participation in the experience, students are expected to be able to manage engineering projects in realistic contexts, connecting project management decisions with technical development, documentation, communication, and sustainability criteria.

The expected learning outcomes include managing projects in the field of engineering; proposing creative solutions to real-world problems; organising activities, people, and resources; establishing non-standardised quantification parameters; preparing technical project documentation; and communicating project results in a professional environment.

Transversal outcomes include teamwork, taking on different roles, effective communication, coordination of technical and management tasks, and reflective improvement through lessons learned and formative feedback.

1.3 Targeted sustainability competences

The experience addresses sustainability competences related to environmental sustainability, the circular economy, and green competences. These include resource management, awareness of environmental impacts, ecosystem protection, holistic and systems thinking, and the importance of education and social awareness.

In the bicycle challenge, sustainability competences are applied through the analysis of viable materials and manufacturing processes, the environmental footprint throughout the life cycle, and opportunities for reuse, repair, and recycling.

Students are also expected to incorporate sustainability and circular economy criteria into their decision-making, evaluate alternatives using green competences, and reflect on the sustainability implications of the proposed design and management decisions.

1.4 Sustainability approach and how it is integrated into the project

Sustainability is integrated as a cross-cutting dimension of the project rather than as an isolated topic. The product itself, a gravel bike, is analysed according to sustainability and circular economy criteria in order to identify improvements that could reduce its environmental impact.

The technical work includes a review of the state of the art, an analysis of alternatives for improving the existing product, the use of a multi-criteria method to evaluate the options and modelling together with structural and aerodynamic analysis before and after introducing sustainability criteria.

1.5 Methodologies and tools used (PBL structure, facilitation techniques, etc.)

The methodology is based on Project-Based Learning, with students working on a meaningful and relevant problem connected to the ENVIHEI philosophy. The approach is student-centered, with an emphasis on teamwork, professional roles, and solving a real-world challenge.

The project management approach is hybrid. The adaptive/agile component is applied to the review of the state of the art, the analysis of alternatives, refinement meetings, short-term planning sessions with objectives of no more than two weeks, and continuous monitoring of team dynamics to detect deviations and implement corrective measures. This allows requirements to be refined as knowledge is acquired.

The predictive component is used for planning, the delivery structure, and project control. This combination allows students to experience different project

management dynamics and understand their application according to the type of task.

The facilitation approach includes role selection through an initial survey and interviews with the teaching staff, regular meetings, progress monitoring, and qualitative feedback aimed at improvement.

1.6 Organization of the project (group formation, timeline, milestones)

The group of students is divided into project teams. Each team assumes both technical and management responsibilities. Key roles include Project Manager, two Team Leaders, Team Coordinators, and Work Package Leaders. Roles are selected through an initial survey and an interview with the teaching staff.

The work replicates a professional project management environment. Students take on different roles and develop two main lines of deliverables: the technical component and the management component.

1.7 Deliverables requested from students (type, format, deadlines)

The technical deliverable is a complete technical project for the gravel bike, incorporating the modifications studied and defined within the project scope and linked to the Project Charter. It includes an extensive review of the state of the art, an analysis of alternatives for improving the existing product by applying green competences, the use of a multi-criteria method to evaluate the options, and modelling together with structural and aerodynamic analysis of the initial situation and the sustainability-oriented alternatives.

The management deliverables correspond to the standard Project Management documentation based on the templates used in the course, such as the Project

Charter, scope management documentation, meeting minutes, lessons learned report, and other project management documents.

1.8 External collaborators involved (mentors, companies, experts...) and their role

MMR Bikes collaborates as an industrial partner. The Engineering Director, Chechu Rubiera, a former professional cyclist, participates in the experience.

The company provides technical documentation on the bicycle and its manufacturing process, provides context on the sector and the sustainability challenges addressed at international trade fairs and events, and offers a professional perspective on the real environmental concerns of the industry.

The overall development of the project involves lecturers from the Engineering Projects Area, a, a panel of experts associated with MMR Bikes, and engineering students working as a multidisciplinary team.

2. Project Evaluation

2.1 Assessment criteria and methods used

The assessment is based on a holistic rubric aligned with the different components of the project (see the detailed adapted rubric here). The documented criteria are: quality of the technical component; quality of project management; integration of sustainability into the analysis and proposals; teamwork, role-taking, and communication channels; and the final solution to the proposed problem.

The rubric provides an overall assessment of the team's performance and qualitative feedback for future improvement, supported by the management

template that records the lessons learned. The experience also includes formative feedback aimed at continuous improvement.

2.2 Evidence of student learning (examples, outputs, results)

The learning evidence includes the technical work of the project, project management documentation, meetings and communication practices, the analysis of alternatives, multi-criteria decision-making, modelling, and structural and aerodynamic studies of the bicycle in its initial and modified configurations.

The documented outcomes and impacts include a greater understanding of the role of Project Management in real-world contexts, increased engagement and motivation, the effective integration of sustainability criteria into decision-making, and the development of technical, organisational, teamwork, documentation, and communication competences.

3. Reflections and Recommendations

3.1 Main achievements and strengths of the project

The main strength of the project is the integration of project management, sustainability, and technical analysis into a real product contextualised within an industrial setting: an MMR gravel bike.

The experience connects students with professional situations, requires them to assume roles and responsibilities, and combines technical deliverables with project management documentation. It also integrates sustainability through the study of materials, manufacturing processes, life-cycle environmental footprint, reuse, repair, recycling, and the circular economy.

Another strength is the hybrid project management approach, which combines adaptive/agile work for research, the analysis of alternatives, and the refinement of requirements with predictive management for planning, the structure of deliverables, and control.

3.2 Challenges faced and how they were addressed

The definition of the project scope and the organisation of the work are identified as the most challenging aspects in the context of international, multicultural, and multidisciplinary teamwork.

These challenges were addressed through a clear division of work among team members, the presence of mentors and supervisors, workshops, additional online meetings, progress reviews, and role-based organisation within the project teams.

The adaptive/agile component of the project also facilitates the management of uncertainty by allowing requirements to be refined, short-term planning to be carried out, deviations to be monitored, and corrective actions to be adopted as knowledge is acquired.

3.3 Lessons learned for future implementations

Future implementations should continue to place emphasis on the early definition of the project scope, the explicit organisation of responsibilities, and structured communication channels, particularly when teams are international, multicultural, and multidisciplinary.

The experience demonstrates the value of combining technical analysis and project management documentation with iterative feedback, lessons learned, and assessment criteria that explicitly include sustainability.

In future editions, it would be advisable to systematically preserve the exact implementation dates, duration, deadlines, final assessment evidence, and supporting materials with consent, in order to facilitate traceability and reporting.

4. Supporting Material

4.1 Lecturers' materials and project documentation

Lecturers' materials and project documentation are available in the following link:

https://drive.google.com/drive/folders/1kXYj-8TyD834AGOWcKClSFC2EuCtemb5?usp=drive_link

4.2 Deliverables produced by students, final presentations or pitch materials

An example of deliverables produced by students is available in the following link:

https://drive.google.com/drive/folders/1UzUWo9EWnHTOidVUh31mqfqFrMvQu7jk?usp=drive_link

4.3 Images/videos (with consent)

Photographic and video records were captured with the explicit consent of the participating students, and are available in the following link:

https://drive.google.com/drive/folders/1pUIZo0Y5AGgq53DHVE33KWbfn_hzOH3z?usp=drive_link

4.4 Any other relevant material

All the materials, including this report, are available in the following link:

https://drive.google.com/drive/folders/1NUO6HlOiaY7n4QCaWn6pooU9DSAqfxzr?usp=drive_link