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ACADEMIC-INDUSTRY SYNERGY, HYBRID AND CO-CREATION METHODOLOGY

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ABSTRACT

Within the framework of the "Product Family Design" course in the third year of design studies, the company Ronal Group Mexico, associated with the university-industry linkage programme (Education Partner), presented the challenge of designing a new wheel rim design specifically for the Mexican market. The company's goal was to create rims with a unique identity, ensuring that these designs were both manufacturable and competitive with European products. To address this challenge, a methodology integrating theory and practice was structured, merging academic content with client needs for contemporary markets within a higher education institution. This approach allowed students to work closely with the industry in an applied and collaborative learning environment.

The design process culminated in the creation of manufacturable 2D and 3D proposals using advanced AI and traditional design tools, culminating in the selection of two designs for production in the Mexican market. This outcome demonstrated the students' ability, with proper management and support, to meet both industry requirements and course objectives. The combination of design methodologies, interpersonal skills (soft skills), and the interdisciplinary approach between academia and industry were key factors in the project's success, fostering educational innovation.

The project demonstrated that effective university-industry linkage (UIL) management is possible within an academic setting, ensuring adequate interdisciplinary synergy between teaching experience, industry needs, and student motivation. This establishes a successful pathway for educational innovation, process analysis to propose sustainable alternatives, and the development of competitive products. As a result, a flexible and applicable methodology is presented, aiming for outcomes that transform academic experience.

Keywords: University-Industry Linkage (UIL), wheel rim design, education partner, higher education, educational innovation.

1 INTRODUCTION

In both past and present decades, the importance and limitations of academia's linkage with labour market dynamics have been discussed [1], [2]. One of the challenges is that the knowledge structured in academic programmes for higher education takes years to develop and implement. When these programmes are finally launched, they often require additional years for consolidation. During this time, industry and services may undergo rapid transformations, especially in the current era, where technology drastically shortens transformation cycles [3]. This creates an opportunity for a stronger connection between industry and academic institutions through flexible, interdisciplinary, and updated methodologies that can effectively address these dynamics. Such a relationship is crucial for higher education, as it enables future professionals to graduate with a better understanding of their markets, services, and job opportunities [4]. For this reason, this article focuses on how a design methodology integrates stakeholders toward a significant impact on teaching and its outcomes. In Latin American markets such as Mexico, applying design to generate value in industries and services is a challenge [5]. Therefore, it is essential to propose design alternatives that create value in these industries through academia, allowing students to apply and validate them in the markets they will enter in the future. Tecnologico de Monterrey, through its Education Partner Programme [6], connects industry and services with the academy to achieve comprehensive results. In this context, Ronal Group Mexico (a wheel rim manufacturing company) participated as an Education Partner (EP) for the fifth semester (third year) Product Family Design course in the Product Design undergraduate programme at the Queretaro campus. This contribution provided an opportunity to design rims with a distinctive Mexican identity, supporting student training under the guidance of academic and industry professionals with diverse knowledge and experience. Therefore, the proposed methodology aimed to integrate the needs of both parties to manage the process efficiently. Table 1 presents the distribution of the population involved in the execution of the project.

Table 1. Distribution of the population involved in the project execution

Category	Description
Student Groups	Two groups from the fifth semester of the Product Design program at Queretaro Campus
Total Students	25 students
Student Organization	12 teams of two-three students each
Academic Professors	5 professors with diverse skills and knowledge forming a complementary team
EP Support	Manufacturing Manager, Marketing Manager, and Director

2 METHODOLOGIES

To achieve the objectives of this study, an interdisciplinary approach was adopted to ensure co-creation between stakeholders, the university, and the industry. The methodology implemented was Agile for product design [7], combining phases, sprints, and academic content applied over a five-week period. Figure 1 shows the hybrid methodology used.

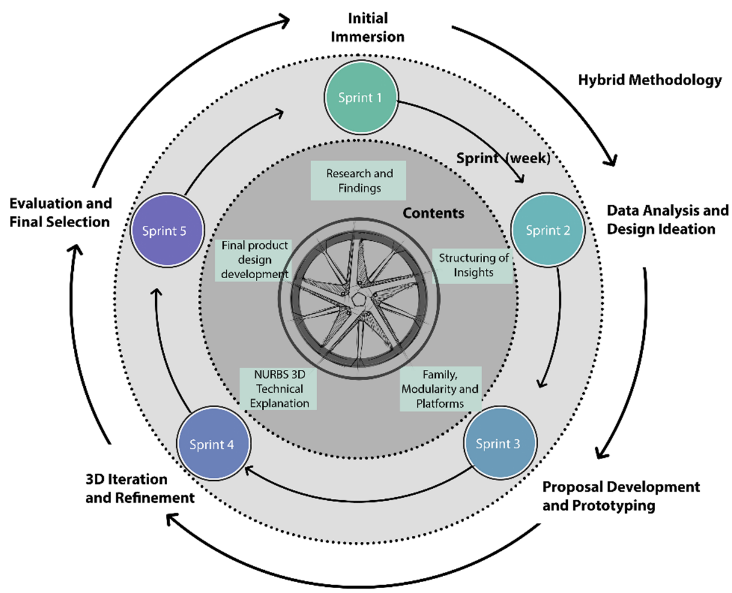

Figure 1. Hybrid methodology graphic

2.1 Integration with the General Objective

A flexible and feedback-oriented general objective was established as the project's central axis. This objective was to design a product family, specifically wheel rims for the Mexican market (with two rim styles: off-road and light vehicles), adapting to both Ronal Group's requirements and educational objectives.

2.2 Agile Methodology Phases

The initial Immersion and Role Distribution consisted of Roles were assigned to determine responsibilities and plan the foundation of the project course. Students worked in pairs with the goal of creating two designs. This process included qualitative methodology and appropriate research methods, involving data collection from the client and market, as well as visits to the wheel rim factory, complemented by discussions with an international expert. After that, the students started with Data Analysis and Design Ideation. Consist in a taxonomic classification of data was performed, applying the *cradle-to-cradle* method and identifying manufacturing and market requirements. Sketching and design conceptualisation began with co-creation and feedback sessions to define needs and ideate product design. Subsequently, it started the Proposal Development and Prototyping. Where the students used Vizcom AI tools for initial visualisations, significantly reducing time and decision-making processes. Teams selected the best proposals representing their concept and intentions. Once completed, the 3D Iteration and Refinement began. With the 2D and 3D (NURBS) models were created using CAD tools like Fusion 360 and AI tools like Vizcom. Rapid prototyping via 3D printing facilitated decision-making, with constant adjustments based on client, faculty, and expert feedback. To conclude, the Final Evaluation and Selection stage. Final 3D models of student designs were printed, accompanied by digital visualisations (rendering) for the in-person final presentation. The general structure of the linking process can be observed in Table 2.

Table 2. General structure of the linkage process

Phase	Sprint Week	Course Content
Initial Immersion	Week 1	Project introduction by the Socioformador (SF), course presentation by faculty. Research and Findings: Human-Centred Design, Design Anthropology, Ethnographic Research. Concept Development, Sustainable Systems: Life Cycle Assessment and Structuring Findings.
Data Analysis and Design Ideation	Week 2	Categorisation and implementation of data, development of initial 2D proposals, and meetings with SF. Structuring of Findings: Information Analysis: Translating findings into functional, constructive, formal-expressive, and sustainable requirements. Development of design brief. Formal exploration through sketching.
Proposal Development and Prototyping	Week 3	Learning 3D techniques and meeting with SF for technical specifications. Product Family, Modularity, and Platforms: Concept of Product Family, Communication, Rapid Prototypes in Soft Materials, Digital Modelling (Fusion 360).
3D Iteration and Refinement	Week 4	Weekly meetings and feedback with SF. Pre-delivery. Technical Explanation of NURBS: 3D modelling with Non-Uniform Rational B-Splines. Robust Design, 3D Modelling and Rendering, 3D Printed Prototypes.
Final Evaluation and Selection	Week 5	Reviewing results to ensure they meet general expectations. Final submission at SF facilities. Final product design development: Various approaches to positioning products in the market within the concept of a Product Family.

For its part, Figures 2 and 3 show examples of the design and prototyping process respectively.

Figure 2. Design Processes (Sketch, Vizcom 2D and Fusion 3D)

Figure 3. 3D printing process (Taking decisions, Final proposals and Presentation)

2.3 Data Analysis

Data analysis in this project was essential to ensure that the design proposals were relevant and competitive. The integration of artificial intelligence (AI) tools and the hybrid Agile methodology enabled efficient and effective data collection and evaluation [8]. The methods used are detailed below. To address this, the Collection and Analysis of Qualitative Data phase began with the Digital Ethnographic Methods where Data platform techniques were used to gain insights into design preferences and cultural analysis of the Mexican market. Following this, the Observation Methods were conducted both physically and virtually during visits to the Ronal Group factory and its digital platforms. Consequently, the Taxonomic Analysis was applied, starting with the Information Categorisation stage, where the information was collected and prioritised to identify the most significant insights. This categorisation facilitated decision-making. Therefore, the Prioritisation stage started, a hierarchy was established within the categories, determining what would generate value for the project itself and, consequently, for the course. As a result, the Impact Assessment with the “Cradle to Cradle” method was applied to identify potential opportunities for proposing sustainable processes in wheel rim manufacturing. After that in the brand identity stage, it was ensured that the final designs were consistent with Ronal Group’s brand identity. In this context, while Catia is a commonly used software for this type of specialised design [9], the specialised software used was Fusion 360 and the AI tool Vizcom for technical design, time savings, decision-making, and data analysis. Finally, the implementation of ChatGPT facilitated data collection and the generation of initial insights, accelerating both the creative and analytical processes. This comprehensive data analysis approach effectively connected theory and practice. The results stemmed from a rigorous process that combined hybrid methodologies and advanced technologies, ensuring that students developed the critical and technical skills needed to tackle professional challenges.

2.4 Skill Development and Market

One of the key outcomes of this activity was the range of skills students developed throughout the project. They worked on sketching techniques, used AI tools like Vizcom for visualisation, and created 3D models with Fusion 360. Simultaneously, they enhanced their ideation, research, and teamwork skills in interdisciplinary settings. From a teaching perspective, this experience highlighted the importance of linking academic content with real projects, helping students apply classroom knowledge. Collaborating with the industry partner also exposed them to professional environments and decision-making in collaborative spaces. This approach fostered hands-on, flexible learning, enabling students to adapt to tools like AI and respond swiftly to client needs. In the end, this helped them gain experience not just in technical skills but also in working together, managing projects, and creating proposals that could reach the market. In conclusion, these projects help students develop skills that are directly applicable to industry needs, giving them a competitive edge. Moreover, such collaborations can drive innovation and economic growth in the region, as they encourage the development of solutions tailored to local markets. Strengthening these university-industry links is essential for building more inclusive and integrated societies in Latin America [10].

3 RESULTS

The implementation of an interdisciplinary methodology based on Agile principles, and the use of advanced tools (AI) has yielded significant results in both academic and professional fields. This approach enabled an effective integration of the needs of EP with the course's educational objectives while fostering a dynamic, practice-centred learning environment. Students successfully developed wheel rim designs that were both innovative and technically viable, aligning with sustainability standards and market expectations. The key outcomes of the applied methodology demonstrate that higher education can be efficiently combined with industrial sector demands within a relatively short timeframe. This interdisciplinary approach not only prepares students for future challenges but also promotes the creation of innovative and sustainable products, significantly contributing to both academic and professional development [11]. Figure 4 shows three different moments of this co-creation experience.

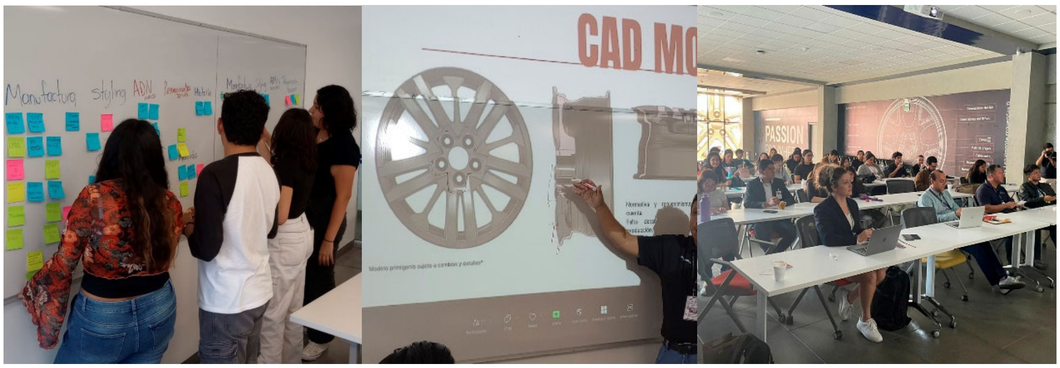

Figure 4. Co-creation (Analysis, Follow up and Delivery)

There were different moments of co-creation, review, analysis, iteration and presentation with the EP. In the Figure 5 The students analyse the manufacturer's requirements and finite details

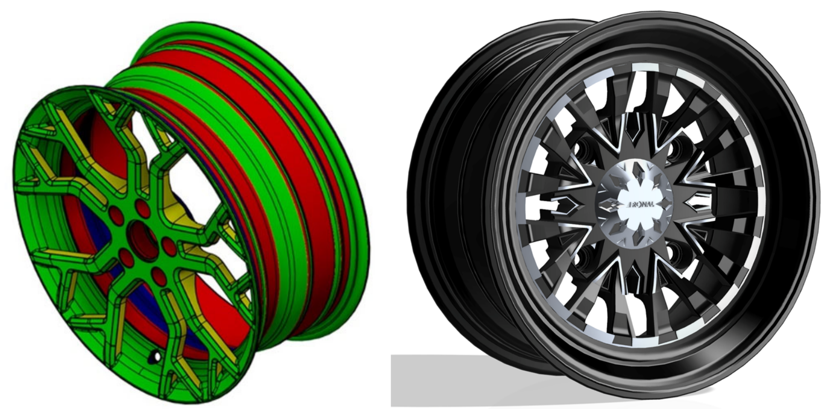

Figure 5. Draft angle Analysis and Rendering

On the part of the students, there was great enthusiasm and commitment during the development of the class. Likewise, they saw the value through design and co-creation for this type of project. In the same way, the EP arranged everything necessary so that it was managed in the best way and contributed to the project being successful.

4 ETHICS AND CONSIDERATIONS

Ethical principles were upheld throughout the project, ensuring transparency and respect for all participants. Students worked within a confidentiality framework with Ronal Group Mexico, guaranteeing informed consent and the appropriate handling of technical and commercial information provided.

5 CONCLUSIONS

Students understand the value of this design methodology in projects and classes, as their outcomes reflect validation from industry partners and their learning process. They also realised the importance of interdisciplinary interaction in managing the design experience and information. Consequently, skills in product design, sketching, AI iteration, and 3D modelling have improved. The Ronal Group, with extensive experience in the rims field, confirmed that the processes and results align with their requirements and market needs. In the final presentation, they expressed how the design value (identity) could enhance their products, methods, and manufacturing processes. Additionally, this article is beneficial for design teachers involved in university-industry linkages, seeking to influence the teaching-learning process while achieving valuable results for industry partners. Although methodologies may vary, translating teaching and project management requirements into a stakeholder-inclusive approach can meet shared objectives. We encourage academic professors to implement methodologies that meet the requirements and expectations of all parties involved. This article demonstrates that the alignment of academic and industrial objectives can be possible and that the use of AI tools, agile methodologies, sustainable processes and co-creation guarantee impactful and relevant results. Active student participation, interdisciplinary supervision, and shared objectives between academia and industry were crucial for success. This case shows that interdisciplinary collaboration fosters both innovation and sustainability. Additionally, the Education Partner Programme generates value within our institution. These partnerships enhance the teaching process and meet EP needs, serving as a learning platform that promotes high participation and collaboration, positively impacting the teaching-learning process.

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